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THE AMERICAN
Journal of Microscopy,
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POPULAR SCIENCE.

VOL. III.

[For the year 1878.]

NEW YORK:
INDUSTRIAL PUBLICATION COMPANY.
176 Broadway.
1878

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THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. III. NEW YORK, JANUARY, 1878. No. 1.

MAR 3

Description of a New Species of Argulus.

BY D. S. KELLICOTT.

I FOUND, parasitic on *Lepidosteus osseus*, taken in the Niagara River, at Buffalo, in September, 1876, an Argulus which seems to be undescribed. I present the following description and figures, and propose the name:

ARGULUS LEPIDOSTEI.

Carapace obcordate, greatest breadth a little more than one-half the entire length of body; convex, transparent, its lobes barely covering the third pair of swimming legs. Eyes brown, compound, having about sixty areolæ. Antennæ, first pair two-jointed, second joint terminating in a slender hook, basal joint nearly as broad as long, having a hook on its anterior margin, also another on its posterior (difficult to show in figure); second pair slender, one-third longer than the first pair, five-jointed, first joint bears a hook at its base, second nearly at right angles to the first (articulation with the same obscure), third as long as the first two, also equal in length to the fourth and fifth together, the last articulation being very slender. There are spines at the articulations. Posterior to the antennæ, on either side of the extremity of the siphon in line with the eyes are two stout brown hooks. Abdomen one-third as long as cephalothorax, as broad as long, deeply notched, lobes acute; on the inner margin near the apex is a slender tubercle with a few hairs; bodies at the base of the lobes (female) large, brown, ellipsoidal. Legs, first pair terminated by suctorial discs, second or ambulatory pair with three strong teeth on the thighs, the outer two rising from the same base, the inner one removed from the outer two one-half its length, more slender, the last joint ends in two hooks; just back of the insertion of the second pair are two pairs of hooks directed backwards; the remaining four pairs, the nalatory legs end each in

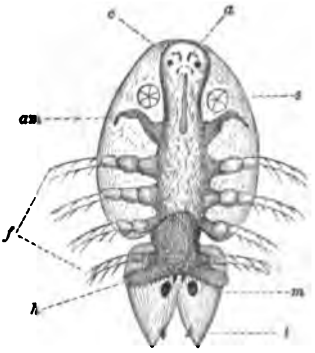


Fig. 1. (♀×3)

FIG. 1. *a*, antennæ; *e*, eyes; *s*, suctorial discs of the first pair; *am*, Ambulatory or prehensile pair; *f*, natory legs; *h*, appendages of last pair; *m*, brown bodies; *t*, tubercles.

two long pinulæ, the third and fourth pairs having an extra recurved pinula; while the third, fourth and fifth pairs are three-jointed, the sixth is obscurely two-jointed, with an appendage at base, these appendicular lobes slightly curved backwards, obtuse, reaching to the margin of the abdomen, covered with hairs.

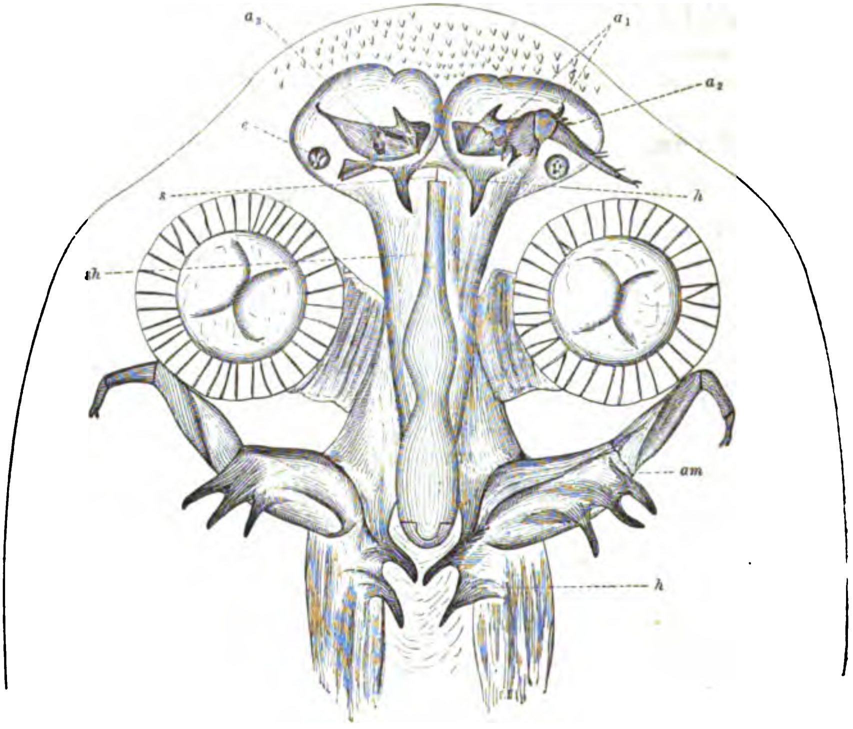


Fig. 2. (×18)

Fig. 2. *a*1, antenna of first pair; *a*2, antenna of second pair; *a*3, antenna of first pair, the corresponding one of second pair removed; *e*, eye; *sh*, siphon; *am*, ambulatory legs; *h*, hooks; *s*, spiculum.

Color light yellowish green, upper part of body blotched and streaked with violet brown. Length of female .36 of an inch, greatest width of carapace .19 of an inch.

Of several individuals obtained all were females.

The favorite place for the parasite to fasten is immediately back of the pectoral fins of its host. It often left the fish and swam about the tank, then returning fastened to any part presented, and crawled to its place near the pectoral fins. I have reason to believe that it may also occupy the gill cavities. I have left individuals alone in a glass of water five days without any apparent loss of vigor.

The blood circulation is very well seen at many points, especially about the eyes and at the margins of the abdominal lobes. The current passes down the inner margin, around the apex and up the outer margin; at intervals along the outer edge lateral currents are given off, which seem to occupy blood vessels proper. The corpuscles are small, apparently spherical and not numerous.

The striped muscular fibres moving the legs and antennæ can be very clearly made out with an inch objective.

The species of this genus are indeed microscopical and zoological gems whose value is not enhanced by their rarity.—*Bulletin of Buffalo Natural Science Society.*

On a New Rhizopod (*Lobularia marina.*)

A Paper read by Prof. R. Hitchcock before the New York Microscopical Society, Dec. 21, 1877.

In looking over some of my late collections, a few evenings ago, I was pleased to find a rhizopod with which I was unfamiliar, and which further study leads me to believe has never yet been described.

At any rate the form in question is one of considerable interest, in that it seems to occupy an intermediate position between the *Lobosa* and the *Reticularia* of Carpenter.

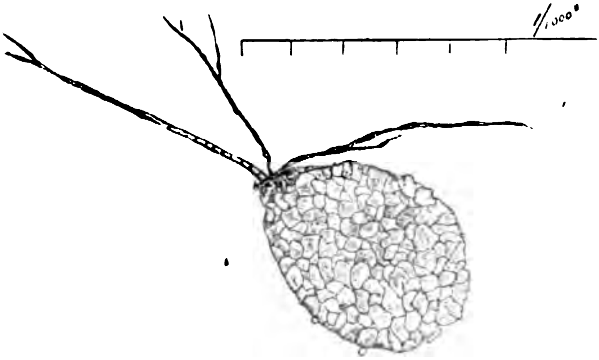


Fig. 1. × .280.

It also tends to show that the classification of Dr. Carpenter, admirable and useful as it has been, is not destined to be permanent, nor would any naturalist consider for a moment that any truly scientific or natural classification could be based on the character of the ectosarc.

Indeed Dr. Carpenter himself, with characteristic foresight, only offered his arrangement for temporary use.

It has served its purpose well, and it will be long before any better classification of the rhizopods will come into general use among microscopists. Still, there has been offered a plan which seems to the writer much better. This is the classification proposed by Dr. Wallich some time ago. According to this plan the *Rhizopoda* are arranged under three heads, as follows:

No definite nucleus, No contractile vesicle,	HERPNEMATA.
Definite nucleus, No contractile vesicle,	PROTODERMATA.
Definite nucleus, Contractile vesicle,	PROTEINA.

Since Dr. Wallich's paper was published, there have been discoveries made which would necessitate some changes in his table (*e. g.* the discovery of a nucleus in some of the Foraminifera would change these organisms from the *Herpnemata* to the *Protodermata*) and we may well suspect the presence of nucleii in all these forms, although not yet demonstrated.

While it may appear from this that Dr. Wallich's classification leaves much to be desired, it still seems much more commensurate with present requirements than does the old division, into *Lobosa Reticularia*, *Radiolaria* and *Spongida.* As regards the form now under consideration, the figures will give a fair idea of its appearance. This notice is merely intended as a preliminary description, for the amount of material was quite limited, and some obscure points, such as the presence or absence of nucleus or contractile vesicle I have been unable to determine. The great obstacle to this was the opacity of the test. However, as soon as opportunity offers I shall procure more of them, and continue their study with reference to these points.

In Fig. 1 is shown the animal as first seen; the outline of the test was drawn with the camera under a power of 280 diameters. The pseudopodia were withdrawn at the time, and I have not been able to catch them since in a suitable position when I could draw them in this way, so they are drawn from memory as first seen.

The description may be given as follows: Test oval, more or less rough, with projecting particles, yellowish, translucent or opaque; mouth usually terminal, sometimes slightly pouting or elongated; pseudopodia very hyaline, very fine, only seen by careful focusing, not numerous (generally only two or three), very long, often three or four times the length of the test; granules very minute and active, moving rapidly up and down the pseudopodia, often in both directions at once on the same branch. The sarcode is often extruded, so as to resemble the pseudopodia of Lobosa in a primitive form, in which case fine threads may be given out from this (see Fig. 2 and description.)

Hab. salt or brakish water near Pelham Bridge, N. Y.

Fig. 2 represents the mass of sarcode extruded in such a manner as would lead one to ally the form to Lobosa. This was drawn by means of the camera lucida, with the exception of the two fine shreds, which were so exceedingly delicate that they could not be drawn with the camera. They are represented very coarsely in the figure. To see these well a power of at least 400 diameters is desirable.

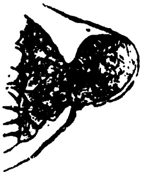


Fig. 2. × .280.

In *Gromia* the sarcode covers the test, and pseudopodia are numerous from all points.

In *Pleurophrys* the pseudupodia are numerous and come out in a mass.

Among the *Lobosa* we have *Trinema*, in which the pseudopodia are limited to two or three, but they are not the same in character as those of the one here described, which are decidedly reticularian and filiform.

It seems that this new form occupies a place between the *Reticularia* and the *Lobosa*, showing at times an extrusion of sarcode resembling Lobosa, at others the exceedingly attenuated filaments characteristic of the Reticularia, and at still other times both types of structure are seen at once.

I would suggest as an appropriate name for this Rhizopod, and one which expresses its relation to the two last named orders, and also its habitat, *Lobularia marina*.

8 *Beekman Place, New York, Sept.* 18, 1877.

Cox's Self-Centering Turn-Table.

THE microscope can hardly be more than a toy in the hands of a person unable to prepare objects for examination. Its highest usefulness is in original research, and the real investigator is necessarily a preparer and preserver of specimens. Hence instruments for microscopical "mounting" are almost as important as instruments for observation. The AMERICAN JOURNAL OF MICROSCOPY has therefore always endeavored to give a due share of attention to mounting apparatus, and, in pursuance of this purpose, has several times published illustrations and explanations of improved forms of turn-tables. Although we have devoted considerable space to this particular accessory of the microscope, we feel that, in justice to the subject, we must present to our readers a description of C. F. Cox's self-centering turn-table, heretofore incidentally referred to in our pages.

Several turn-tables have been devised which will centre a slide as to its width only, the most effective of these being probably the form devised by Dr. J. Matthews,

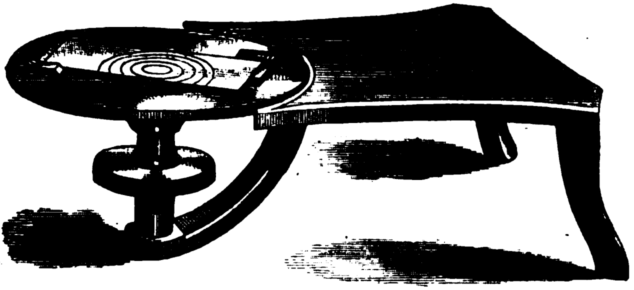


Fig. 1.

exhibited by him to the Quekett Club, described in *Science Gossip* for July, 1870, and afterwards illustrated and commended in the second edition of Thomas Davies' work on mounting. In *Science Gossip* for January, 1876, it was announced that Mr. Charles Butterworth had exhibited to the Oldham Microscopical Society a turn-table, by the aid of which cells could be made with the utmost precision and despatch, and that, too, not only in the circular, but also in the elliptical form, of any size from 2 inches in length by 1 inch in width, reducible until a perfectly straight line was produced; but this ingenious contrivance must have been too complicated or too expensive for general use, for we have heard nothing more of it.

Mr. Cox's invention is intermediate to the two just referred to, both as to the time of its announcement and as to the purposes accomplished by it. It does more than Dr. Matthews' turn-table, and somewhat less than Mr. Butterworth's, and is therefore perhaps more generally useful and practical. It was first described in the *Monthly Microscopical Journal* for March, 1875. By one of those curious coincidences which often occur in the scientific world, Mr. C. Mason Kinne, of San Francisco, was working upon essentially the same idea at about the same time, although we have reason to believe that he and Mr. Cox had never met, nor heard of each other's self-centering apparatus, prior to Mr. Cox's announcement of his invention in 1875.

Cox's self-centering turn-table is, in its general form, similar to the common Shalbot turn-table, long in use with microscopists, as is evident from Fig. 1; but, to accommodate the centering appliance, it is necessarily a little larger, the brass revolving plate being about 4 inches in diameter. Fig. 2 represents a perpendicular section through the line of the milled-head and spindle. The glass slide is grasped, at two opposite corners, by right-angled clutches C C, which are attached loosely by screws

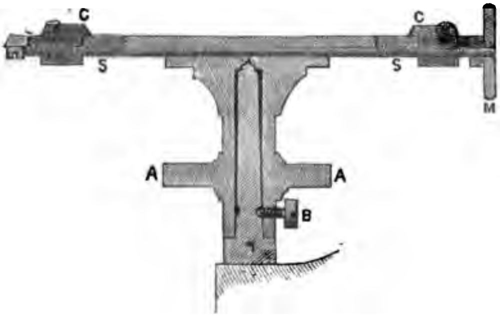


Fig. 2.

to lugs which move upon the spindle S S, which is cut into right and left hand screws, so that when the milled head M is turned, the lugs move towards or recede from each other at a uniform rate, guided by the slots cut through the table on a line with its exact centre. The clutches turn so easily upon the screws which attach them to the lugs, that they adapt themselves, without assistance, to a slide of any shape approximating to rectangular. The size of the slide which can be centered on this table depends upon the play allowed the clutches by the length of the slots, but there is no difficulty in making a table of 4 inches diameter which will centre any slide from 1½ inches square up to 3½ by 2½ inches.

One of the advantages of the right and left screw is that it is sufficiently unyielding to afford a firm hold upon the slide, so as to enable one to turn down or smooth off hard cells, as in a lathe. But, aside from this, it seems to us that it must be more accurate in its operation than any other device for moving the clutches could be.

It is manifest, from what has already been said, that the point of revolution of the slide as it lies upon the table *must* be the exact middle of its diagonal, and this, with a rectangular slide, will always be the true centre as to both width and length. This secures perfect concentricity in finishing and establishes a standard of nice work; for no matter how many applications of cement or varnish it is necessary to apply, the slide always assumes the same position on the table, and the different layers must therefore coincide. Moreover, work done by a preparer upon one of these tables may always be refinished without trouble by any other person upon another similar table. For placing cells for opaque objects, its operation is obvious; but for mounting transparent objects also it is a great convenience. The glass slips that are to be used should first be centered on the table, and receive a ring of ordinary water-color or of ink on the opposite side from that on which the object is to be placed. This will serve as a guide to the proper location of the object and the cover-glass. When the balsam or jelly has hardened, and the slide is ready for finishing, this temporary ring may be wiped off and the cover will be found in the right position to receive a neat and accurate ring of varnish or paint.

It is hardly fair to require improved forms of scientific apparatus to conform to the defects of the apparatus it is intended to supersede, but unfortunately in the case of this turn-table the chief objection that has been made to it is that it is too accurate to be of service in refinishing inaccurate work; and so Mr. Cox has adapted to it a spring-clip, which may be put on or taken off in an instant, thus temporarily converting his table into the unimproved form, for the purpose of repairing old slides which have not been truly centered. This arrangement is shown in Fig. 3.

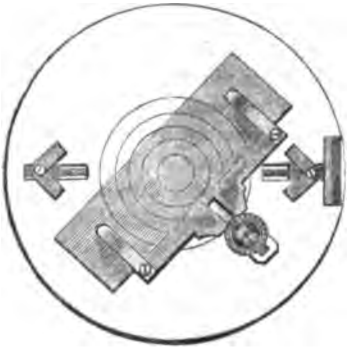


Fig. 3.

By the addition of two brass triangles, the right angles of which are placed in the clutches, so that the opposite sides press upon and hold the glass slide, as shown in Fig. 4, this turn-table is made to accomplish the same end as Dr. Matthews' device—namely, the centering of the slide as to its width only. This is useful mainly when it is desired to make several cells upon the same slide from end to end, although under some circumstances the triangles will assist in refinishing badly placed specimens. This application of the triangles, we are informed by Mr. Cox, was originated by him, and described in correspondence with Dr. R. H.

Ward, who first called attention to it in the *American Naturalist* for May, 1876, although an error was then made in saying that the triangles must have the sides adjoining the right angles just one inch in length. In fact the dimensions will be considerably greater than thus indicated, and will be easily ascertained by experiment for any particular table. These triangles should be cut from sheet brass about as thick as an ordinary slide, or a trifle thicker, and should be exactly alike for the purpose of making cells along the median line of the slide. By using a series of triangles of different sizes, a group of small cells may be made, to be covered by a single thin glass, which is a neat arrangement for typical slides of diatoms, foraminifera, etc.

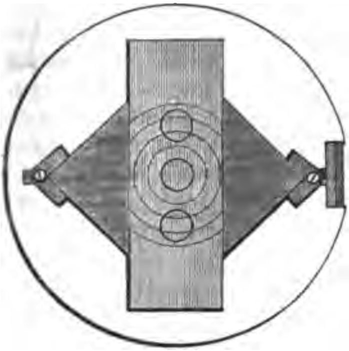


Fig. 4.

◆

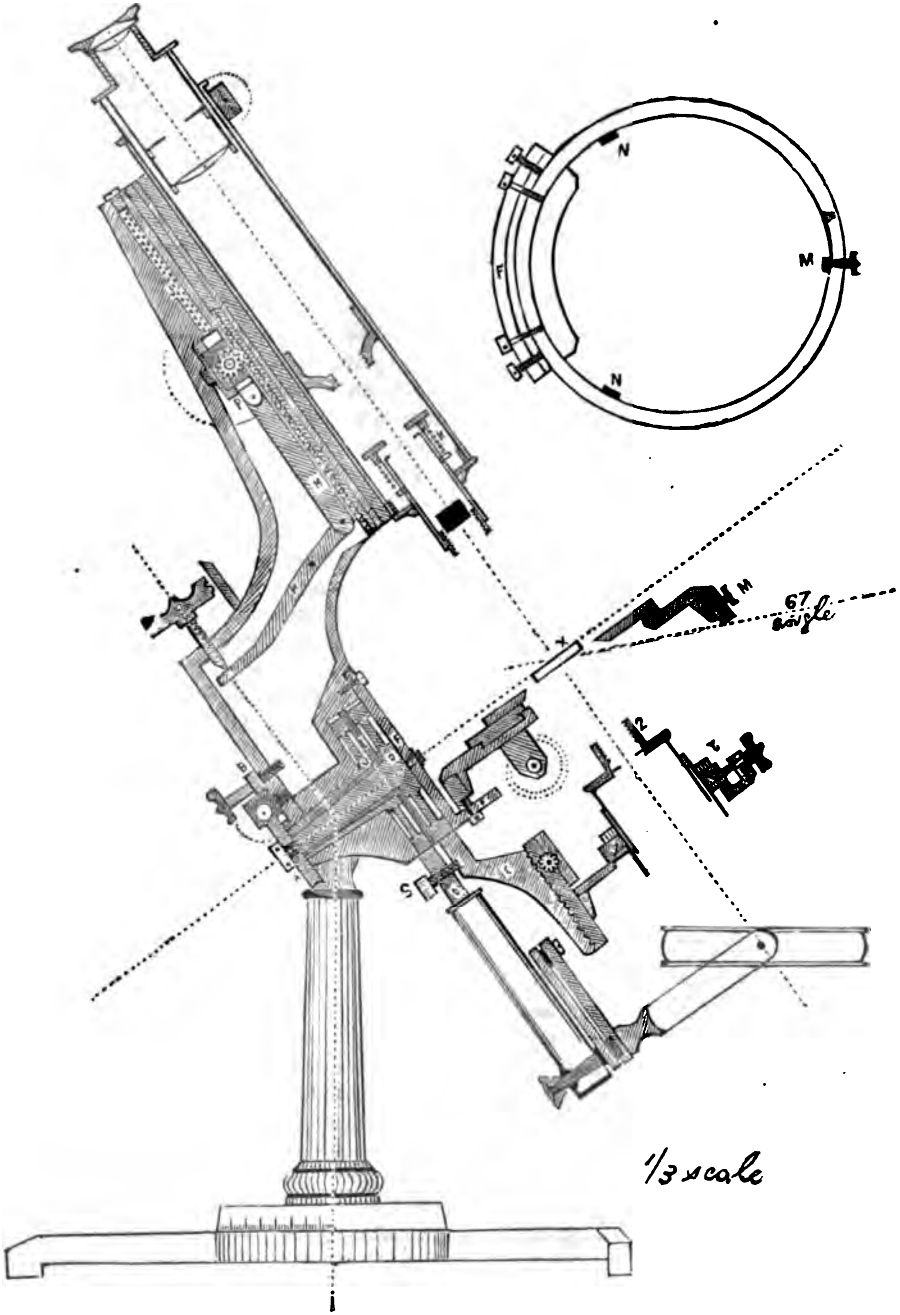
Bulloch's New Microscope.

As our readers are all more or less interested in any improvements of the microscope which may be introduced from time to time, we give here a cut and description of the new stand recently constructed by Mr. Bulloch, of Chicago. This instrument possesses several points of novelty, and the details are well seen in the sectional view shown in Fig. 1, and the general appearance of the instrument in Fig. 2.

Referring to Fig. 1, it will be seen that the fine adjustment is worked from the back of the instrument, and moves the entire body without changing the distance between the objective and eye-piece. The levers, H H, act directly upon the sliding box, which contains the pinion of the coarse adjustment, and this is in turn pressed down by a strong spiral spring above it. This arrangement, it is claimed, secures more freedom from lateral motion in the use of the fine adjustment than any other method yet devised, and at the same time does away with the tremor unavoidable when the double slide is made use of. To avoid the danger of breaking the cover-glass, the tube is provided with the ordinary spring safety tube, as shown at K, and this is an important addition which some makers who employ a similar focussing arrangement have disregarded.

The method of centering the stage is shown in the small figure in the upper right hand corner. The ring here shown carries the stage-plate, and is centered for any objective by means of screws passing through the piece F, which is fastened firmly to the limb. The ring may be clamped in any position by a screw passing up through the bottom of F, which may be seen in the largest drawing. All these screws have perforated heads, and are readily turned by a bit of steel wire. On the inside of the ring are three small projections, which afford bearings for the stage to move upon and diminish friction. At M is shown a screw for clamping the stage in any position. Experience has shown that this stage is capable of being accurately centered for a 1-25th objective. The mechanical movements are exceedingly smooth, and consist of a screw for the horizontal and a chain for the vertical directions, both controlled by milled heads upon the same axis, as seen in Fig. 2, where the stage is represented turned nearly 90° from its ordinary position.

We have now to consider the matter of the mirror and sub-stage, to which allusion has already been made in this journal. In this connection Mr. Bulloch's instrument contains several novelties which add greatly to its completeness and convenience. The mirror and sub-stage both move about the same centre, which is at a point just the



1/3 scale

Fig. 1.

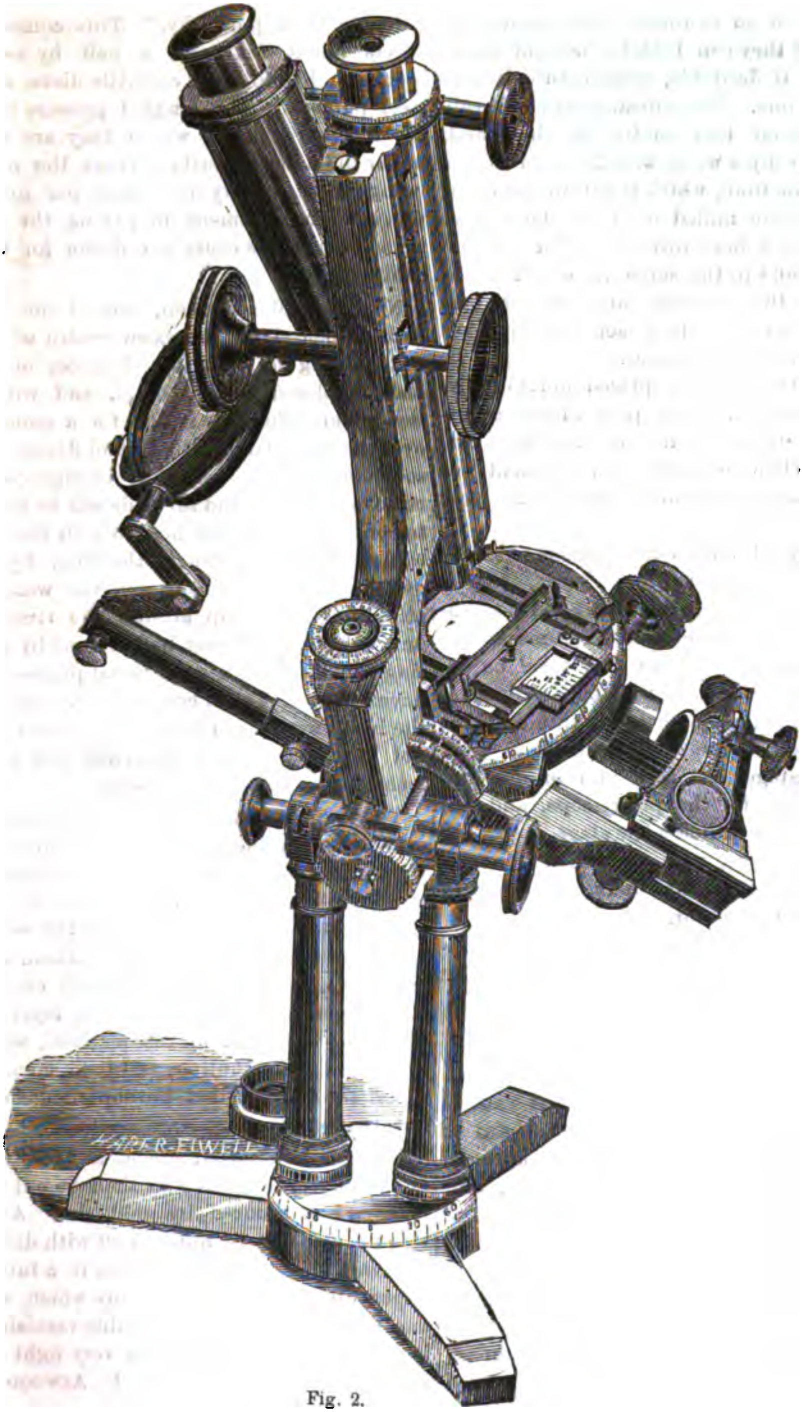


Fig. 2.

thickness of an ordinary slide above the stage, and they can both be brought above the stage, if desirable, without substituting a thinner one. The sub-stage can be freely moved about this centre by the hand, directly or by a worm wheel, shown at the back of the limb, which is thrown into gear by turning the milled head, B. One great improvement here introduced for the first time is found in the screw S, which serves to clamp the sub-stage and mirror bars together, so that they act the same as though made in one piece.

When the body is placed horizontally, as for drawing, every part moves accurately about the same centre, X. Mr. Bulloch claims that this arrangement was first devised and used by him in the year 1878.

We conclude with some extracts from the maker's description:

It has the concentric rotating and mechanical stage, with graduations for measuring angles, and adjustable so that it can be accurately centered under a 1-50th objective. The whole stage is sufficiently thin to admit an angle of oblique light as high as 134°. The sub-stage has rack and pinion, and divided circle for the polariscope, and can be used above or below the stage.

The sub-stage, with its milled heads, is easily taken off, so that there is nothing in the way of the mirror.

Both mirror and sub-stage have graduated circles, so that the obliquity of the light can be noted.

Mounting on Wax.

THERE are probably few of the readers of this journal who have not heard of wax being recommended for a background for objects to be mounted dry opaque, but, lacking explicit directions for its use, have never tried it. The object of this article is to give the process used by the writer, in hopes that it may be of value to other amateurs.

The wax is procured from dealers in artist's materials, and the kind I use is called "double thick pond lily." This comes in sheets about four and a half by seven inches, and from this I cut little disks, with steel punches. The rings I procure from the hardware stores, where they are sold under the name of curtain rings, the price being about twenty-five cents per gross; this is an improvement on paying the optician twenty-five cents per dozen for vulcanite rings.

Now, to make the cell, one of the wax disks is placed on the exact centre of the slide, a ring not quite the diameter of the disk is placed on top of it, and with a steady hand the slide is held for a moment over the spirit lamp with a small flame. As soon as the wax begins to change color, remove the lamp, and the slide will be found to contain just enough heat to melt the wax to the right consistency; the ring, by its own weight, sinks into it, and the wax, by attraction, comes up around the ring; so on cooling—which may be hastened by putting the slide on a cold metal plate—you have a beautiful semi-concave cell. Should the heat have been too severe, the wax will not look well; a little practice will soon teach one how much heat to use.

To mount Foraminifera, sand, or similar substances on the wax, I put the slide on the turn-table, revolve it briskly, and apply the blunt end of my forceps carefully against the ring. This brings the cell to the exact centre of the plate. Then, dipping a small brush into a diluted cement made from shellac, I paint a *thin* layer on the wax; then put on the material, whatever it is I am mounting, and in a moment invert the slide, so that the superfluous material may be saved.

In a few hours your object is firmly set, and the covering glass may then be put on, it being best secured by gold size. After this the cell may be finished off with different varnishes to suit. I will, in a future paper, give simple receipts by which any one may prepare a good durable varnish of any color desired, and at a very light expense.

H. F. ATWOOD.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

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We can no longer supply complete sets of Volume I in sheets, but offer all the numbers except Nos. 1, 4 and 8 for 25 cents, by mail, postpaid. We have on hand a few complete copies of Volume I, handsomely bound in cloth, with gilt title, price $1.25. Volume II is also complete, and may be had in numbers for 50 cents; or fresh clean copies, with large margin, bound uniformly with Volume I, for $1.25.

As we desire to p'ace a COMPLETE set of the Journal at the disposal of our subscribers at a moderate rate, We offer Vols. I and II, bound, and Vol. III in numbers as issued, for $2.50. Those who wish to have their numbers of either Vol. I or Vol. II bound can do so for 35 cents. Postage 10 cents additional.

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

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S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 88 State Street, Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Notice to Subscribers.

THE present number of the JOURNAL will be sent to all old subscribers except those who have positively ordered a discontinuance. We hope that those who intend to subscribe for next year will remit as soon as possible. Those who order through our agents are, however, requested to make payment to them.

The Death of Dr. Lawson.

SINCE our last issue we have further particulars of the death of Dr. Lawson, editor of the *Monthly Microscopical Journal.* This sad event took place at Cork on the 4th of October. Dr. Lawson edited the *Monthly Microscopical Journal* from its commencement, and also held the appointment of Assistant Physician and Lecturer on Physiology at St. Mary's Hospital. He had been in failing health for several years, and left London for his autumn holiday with little hope of return. He was comparatively a young man, being only in his thirty-seventh year. With his death the publication of the *Monthly Microscopical Journal* ceases, and in future the Royal Microscopical Society will publish their own transactions. Whether these will be available to the general public or not, we are not advised.

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Cleve's Diatoms.

WE are glad to learn that Prof. Cleve proposes to issue the second series of his Diatoms, and hopes to have them ready early this year. This series will contain sixty slides, and among other varieties and curiosities, new species of Amphora, Nitzschia, Rhizosolemia, Asterionella, etc.

Our previous notice has brought forward a few subscribers to this series, and we hope, in the cause of science, that several more will send in their names. Every active microscopical society in the country ought to possess the series of Prof. Cleve, and also that of Prof. H. L. Smith.

◆

Material for Mounting.

THROUGH the kindness of Mr. C. M. Vorce, of Cleveland, O., we are enabled to distribute some very fine diatomaceous material, obtained by filtering large quantities of the water of Lake Erie. A small quantity will be sent on the usual terms—that is, to all our subscribers that request it and enclose a stamp.

The New York Microscopical Society.

IT is gratifying to learn that the endeavors of a few enthusiastic gentlemen, who have lately given their best efforts to the establishment of a microscopical society in this city, have been crowned with success. The New York Microscopical Society is now thoroughly organized, and before many days will possess a charter giving all desirable powers and privileges. A short account of what has already been accomplished may not be without interest to our readers.

The first communication regarding the proposed organization appeared in this journal a short time ago. This was from Prof. Hitchcock, who desired all who felt an interest in the project to communicate with him. Not a single letter was received, but this was not taken as an indication that such a society could not be formed. Another effort was therefore made, and on the 12th of November letters were sent to twenty gentlemen known to be interested in microscopy, and also to be unconnected with any existing society of the kind, inviting them to meet at the residence of Mr. W. C. Hubbard, at 8 o'clock on the evening of the 14th. These letters were signed by R. Hitchcock, J. D. Hyatt, J. L. Wall and W. C. Hubbard.

Promptly at the appointed hour the meeting was called to order, a chairman and secretary elected, and it was decided to form the society at once. At this meeting there were twelve gentlemen present, who, with a single exception, were convinced of the practicability and advisability of this course. Prof. Hitchcock had prepared a draft of a constitution and by-laws, which was read, and the discussion for the few succeeding meetings was almost exclusively upon these.

After much consideration, both by the society and special committees, and very material alterations of the original, the constitution and by-laws were finally adopted at the last meeting held Dec. 21.

The election of officers for the year 1878 was held Dec. 11, which resulted as follows: President, J. D. Hyatt; Vice-President, G. I. Whitehead; Corresponding Secretary, A. J. Swan; Recording Secretary, R. Hitchcock; Treasurer, W. C. Hubbard; Librarian and Acting Curator, D. B. Scott. The permanent committees were appointed at once, and the society is now thoroughly organized and prepared for work.

The majority of the members are gentlemen of ability and energy, and are resolved to keep up the standard of the society, so that membership alone shall give one a recognized and honorable place among microscopists. It is determined that all charlatanism shall be excluded, and nothing but what is strictly scientific in character shall receive attention or support. All papers to be read before the society are first examined by the proper committee, and become the property of the society.

The meetings are held on the first and third Fridays of every month. Hereafter notices of the proceedings will be published in the proper column of this journal.

There is abundant room in this city for several societies, and we would strongly recommend to such of our readers as are interested in microscopy, that they affiliate themselves with some one or other of those now in existence. We also trust that the kindred societies throughout the country will extend to their younger sister such courtesies as may lie in their power, such as donations of materials and exchange of papers, etc. We know that the new society has the power and the desire to reciprocate liberally.

We would call the attention of our societies to the advantages of the system adopted at the last meeting of the New York Society. We refer to the practical illustrations of working methods given by Mr. Scott. Such demonstrations are frequently given before the members of the London societies, and also, we believe, before the San Francisco society, and we feel assured that nothing can be done which will tend more directly to the improvement of the younger members.

Fraudulent Lenses.

In a recent issue of the *Medical Record* we find the following:

> FRAUDULENT LENSES.—A decided impression has been created in scientific circles in this city, by the discovery that one of our most noted opticians is in the habit of importing from Paris ordinary commercial lenses, remounting them after the English style, and palming off such inferior productions as lenses of the best makers. The fraud was discovered by one of our microscopic experts, who was called in to evaluate the stand, lenses, and other microscopic appliances, left at the death of a physician of considerable prominence in this city. The stand had the name of a prominent manufacturer. The lenses, supplied by the same house, were duly labeled with the name of a celebrated maker, but, on testing, did not yield the results of genuine Wales glasses. Closer inspection, guided by the peculiar color of the field, when used with a student's lamp burning kerosene, led the expert to suspect that he was dealing with objectives manufactured in Paris, it being a fact familiar to experts that objectives of Vienna, Berlin, Paris, London, or American manufacture, have each their own peculiarities as concerns the tint of the field, by which they can be identified with tolerable certainty. Subsequent inquiry established the fact that our expert was correct in his induction, and eventuated in the exposure of a fraudulent practice, that has probably been carried out by American opticians for a long time.

The above appeared among the minor items of news, and, we presume, was clipped from some of the daily or weekly papers, as it bears internal evidence that the man who wrote it knows nothing about objectives. That any of our "noted opticians" would do what is here alleged is highly improbable, and it is equally improbable that any prudent dealer would be guilty of such practices, from the simple fact, if from no higher motive, that detection would be prompt and certain. The difference between "commercial lenses," as they are called, and the objectives of Grunow, Gundlach, Spencer, Tolles, George Wales, William Wales, and Zentmayer, is so great that no person could own a "commercial" lens a week, and read any elementary work on the microscope, without finding out that his objective was not up to the mark. In that case it would be sent back to the maker for readjustment, and the fraud would be sure to be detected.

In our "Practical Hints on the Selection and Use of the Microscope," we described a somewhat similar fraud which has long been in practice. We allude to the custom which some *dealers* adopted of mounting these French triplets after the American fashion, and selling them as *their own*. In this way they obtained a high price for the extra brass work and boxes, and as the lenses were sold as second or third quality, they were not liable to be compared with the objectives of any of our noted makers. Fortunately the extremely low price at which really good objectives by American makers may now be obtained, has rendered this business unprofitable. When a common-place quarter cost forty or fifty dollars, these revamped triplets could be easily sold for $15 to $20. Now, however, when an objective which will resolve the *P. Angulatum* by central light can be had for $15, there is no room for speculation in this direction.

While on this subject of fraudulent lenses, we may note a curious case which once came under our notice. A gentleman purchased a quarter-inch objective from a young optician, who sold it as his own production. It was a pretty fair lens, and brought a good price. An accident happened to it, however, and it was placed, with some other things, in the hands of a well-known maker for repairs. What was the surprise of the latter to find that it was one of his own old lenses, which had been transferred to new brass work! In this case the young workman was evidently animated with a desire to obtain credit for an honor which did not belong to him. Such a fraud would be detected only by the merest accident, because in the case of repairs being needed, the rule is to return the objective to the maker. No microscopist would think of consigning a valuable lens to the hands of any one except the man that made it, and very few of our opticians will touch the objectives of other parties. In this case, however, the putative maker was not of such repute as to compel the following of the rule in his case, and as other things were going to a "noted optician," the lens went with them, and was immediately detected.

Our Book Table.

Biology: With Preludes on Current Events. By Joseph Cook. Three colored plates after Beale and Frey. Boston: James R. Osgood & Co.

This book will, of course, from its very title, attract the attention of the readers of this journal, who will doubtless be led to suppose that they will here find a work in which the science of Biology is popularized. In this, however, they will be mistaken. As a source of information on biological subjects, the book is entirely worthless. Mr. Cook has evidently had no scientific training; he has been educated in the old classical rut, and supposes that he can *cram* for a lecture on biology, just as he would for an essay on some literary topic, and the result is a curious caricature of science. His entire want of scientific training is shown in his objections to Huxley's drawings of the Eocene horse. For the purpose of making them visible to a numerous audience, Huxley had them drawn on a large scale; Mr. Cook objects that the Eocene horse was not larger than a fox, forgetting that even if this were the case, the gap (so far as mere size is concerned) between the Eocene horse and some of our ponies is not greater than that between these ponies and the elephantine dray-horses of London and Liverpool. Yet who would deny that either the ponies or dray-horses are horses?

Such illogical statements are evidently due to the fact that Mr. Cook is a partisan of the most noxious type. He has entered into what he and some others are pleased to call the conflict between science and religion, blind to the fact that there can be no conflict between science and religion, whatever bickerings there may be between so-called scientific men and theologians. Such bickerings do not effect either true science or true religion, but it happens, unfortunately, that they frequently place the advocates of certain theological tenets in a very anomalous position. When a silly and fanatical bishop advises the congregations under his charge to refuse the ordinary hospitalities to a stranger and foreigner, his conduct is certainly neither religious nor Christian. And when the editor of a prominent religious journal hurls his anathemas at a scientific teacher, and the latter adopts the Bible precept, and refuses to return railing for railing, but contrariwise blessing, it would seem to a mere looker-on that the scientific man is in reality a better Christian than the religious editor. Mr. Cook, by the pungency of his language, adds to the bitterness with which these two parties regard each other, while by the weakness of his arguments he must lead every thoughtful scientific man to conclude that the cause which he (Cook) advocates is, to say the least, based on a very insecure foundation.

This book, however, may teach the thoughtful man two very important lessons—lessons, it is true, which Mr. Cook did not intend to teach, but which for all that are none the less pointedly enforced. The first is that the mere excitement and unbridled enthusiasm of so-called revivals are dangerous guides. Mr. Cook has been engaged in one of these revivals in which his lectures have been greeted with the most rapturous applause, an applause which has so far intoxicated him that he has not been able to resist the temptation to embody in his printed volume those parenthetical expressions which are appropriate to second-rate political speeches only. Nay more, he has been made an idol by Young Men's Christian Associations, who have hailed him as a defender of the faith, and every religious journal that we have seen has commended his work. And if further evidence of the extent to which the masses have been carried away were needed, we have it in the fact that a man in Western New York, who is evidently more remarkable for zeal than for knowledge, has paid this man Cook a liberal fee to deliver a course of free lectures, before a theological seminary! Now, the joke is, that if these same young men could only understand what Cook writes, they would know that the book before us contains matter as thoroughly hostile to the Christianity which is held alike by Roman Catholics, Baptists, Episcopalians, Methodists, Presbyterians, etc., as the writings of Strauss and Renan! If *we* had written pages 115, 116 and 117 of this book and published them in this journal, every preacher and every Young Men's Christian Association in the country, that thought it worth while to notice us at all, would have held us up to execration as an infidel and an atheist! This is no overdrawn picture, for on these pages, Cook offers Parthenogenesis, or the well-known fact that amongst bees and some other insects, virgin mothers produce young, as a possible explanation of the Incarnation!! And yet Young Men's Christian Associations welcome him to their platforms, and the members crowd to hear him, though, let us hope, for consistency's sake, not to understand him.

The second lesson is one which is still more important, and which has often been inculcated in these pages. It is that the only road to sound scientific knowledge lies through hard and earnest *practical work*. No man can acquire a useful knowledge of biology by merely reading Beale, or Huxley, or

Agassiz. A few months' steady work with a microscope, under proper guidance, even though the instrument be a poor one, will give a clearer knowledge of the science of biology, and a more intimate acquaintance with its facts and principles than can be obtained by reading all the books in the Boston Athenæum, which Mr. Cook is so fond of calling his library.

The day is past when science could be studied satisfactorily in the alcoves of a library without practical work. Those who think otherwise had better retire to the cloisters and abbeys of the middle ages.

Croton Water, Its Nature, Properties and Impurities, with Original Microscopical Drawings of the Organic Deposit. By John Michels, author of "The Microscope and its Misinterpretations," etc., etc., etc.

This pamphlet is intended primarily to advocate the use of filters in the purification of water. Mr. Michels has drawn not only upon his own observations, but upon the recorded results published by some of our ablest and best analysts. It requires no microscope, however, to convince any person of ordinarily delicate tastes that the water supply of most of our cities requires thorough purification before it can be fit for drinking or cooking purposes. Careful inspection with the naked eye alone will prove that. The great danger, however, arises, not from organisms which can be detected by the microscope, but from soluble matter, which nothing but the tests of the chemist can disclose. How far the filters which Mr. Michels advocates will remove these impurities, we are unable to say, as the construction of the filter is not explained. Mr. Michels has done a good work, in calling attention to the necessity for purification, though it is but fair to him to say that he has not undertaken to play the rôle of an alarmist.

The Microscope. Being the Article Contributed by Andrew Ross to the "Penny Cyclopædia," published by the Society for the Diffusion of Useful Knowledge. Fully illustrated. Price 75 cents. New York: Industrial Publication Company.

The name of Andrew Ross will ever remain indissolubly associated with the greatest improvement thus far made in the compound microscope, and his papers in the "Transactions of the Society of Arts," and the "Penny Cyclopædia," must always possess a deep historical interest. In addition to this, however, they possess a practical value which renders them of great importance to every student of microscopy. All our most important text-books—Carpenter, Hogg, Brooke, etc.—refer the student to the papers of Ross for more complete information. Unfortunately, however, they are inaccessible to the majority of microscopists, being locked up in expensive works which are now out of print. A cheap reprint must therefore prove acceptable to many.

The article by Ross, as reproduced in the volume before us, is remarkable for its clearness, its simplicity, and its directness. It is not difficult to understand, and he who fully and clearly understands it must have a pretty fair foundation for a thorough knowledge of the microscope.

Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Angular Aperture Once More.

Ed. Am. Jour. Microscopy—The discussion between Prof. Hitchcock and myself, which, during the last few months you have done us the honor to print, seems to have become somewhat of a rambling nature. Prof. Hitchcock "changes base" so often, that it would bother a streak of lightning to catch—much less corner him. Be this as it may—and perchance he might return the compliment, I can only say that I have endeavored to stick to the points at issue—the merits of high, as compared with low angles, I have attempted to set forth from a *practical* standpoint, being tolerably familiar with the use of either style of glass.

I have tried my best to have Prof. Hitchcock examine high-angled glasses for himself, and report results, but, as your readers are aware, from his own assertions, Prof. Hitchcock does not claim a *practical* knowledge of them, and as a matter of course he cannot see what that "handling" (of which it will do so well "to talk about before an audience") amounts to. Of a piece with this comes his statements that such and such positions of my own are "not proved," and that before he accepts them he "must *know why*."

I submit: that the only possible method of convincing Prof. Hitchcock will be the practical one, in this instance, however, quite *impracticable*, to wit: "two (or more) hours *conjointly* over the tube," or until he shall have done me the honor to adopt my suggestion, and experiment with the high angles for himself; in the latter case, obviously, he ought not to expect first-class results from the wide angles until at least he shall have learned that something is due to "handling." I repeat that until one or the other expedient is adopted, we might continue the present discussion until doomsday, and on my part without a vestige of any chance of convincing Prof. Hitchcock. I therefore offer the following brief remarks by way of closing a controversy which, in the nature of things cannot lead to any fixed results.

Prof. Hitchcock asks, "Why strain a one-inch to see 30,000 lines to an inch, with a deep eye-piece, when the half-inch would do the same work without being pressed so hard?"

Well, let us strip things "stark naked," and find out "why." First, with the inch I get better definition; second, longer working distance; and, third, because the inch, with "deep eye-piecing" is not pressed so hard as the half-inch—and this is my reply to Prof. Hitchcock. As a matter of course he will come back at me with the stereotyped assertion "I must know why." He says, too, "Until his (my) experiments are published and subjected to public examination they are not to be accepted, etc." Well, by the laws, my experiments *have been* both published and subjected to public examination. But, unfortunately, Prof. H. wasn't there! Note that.

Further, I now propose to put the inch and half-inch to a practical test. Thus, let Prof. Rodgers, of Cambridge, rule a band of 40,000 lines to the inch, and let Prof. Hitchcock count them if he can with a low half inch (say of 40°). I hazard the prediction that he will fail, and furthermore, that I will be enabled to count them with an inch of 45°. I am ready for such test in any shape that Prof. Hitchcock may suggest.

To get back to our 'moutons.' When I stated 30,000 as the limit for definition of the inch, I held a good large margin (to swear by) in reserve. This, as the 30,000 was "millions" as far as establishing my point was concerned, now that the readers of this journal have got used to the "30" dot, I will add that I have no trouble in seeing the 40,000 band of a Rodger's test-plate, and most beautifully ruled they are. Here is an added strain of ten thousand on the inch, but it is as good as ever! (One of these days I must give your readers a description of an exquisitely ruled plate, up to 80,000 to the inch, and by the same talented artist.)

But to business. I have as fine a half-inch of 38° as I have ever seen, a glass selected with much care, having spent considerable time in making the selection, so as to have the very best; for, be it known, I *sometimes* (not often) have use for just this sort of glass. Well, now, this half-inch has shorter working distance, and, as a matter of course, less penetration than has the inch of 45°, while the last-named inch of 45° has much the *superior definition*.

Now, I am perfectly acquainted with the "points" of these two objectives, and can make either put its "best foot foremost," (hence the "handling" may be counted out.) Both are my own, and I can at will use the one that I prefer. Which would Prof. Hitchcock use under the same circumstances? Or, leaving the Professor out, which would the reader elect? Which glass would be "strained" the most?

Prof. Hitchcock reminds his readers that he has "already admitted to Prof. Smith that Tolles and Spencer are making wonderful glasses, etc." Yes, so he did, but he put a fence round them; thus he adds "but for *resolutions only*." When Prof. Hitchcock shall become as well acquainted with the work of Spencer and Tolles as are others, that fence will step down and out. I accept no loop-hole, but stand to the positions heretofore assumed, to wit, that the above named glasses are not equaled for "any and all work," as set forth in my last paper.

Now about Dr. Johnson's showing the 19th band as an opaque object in the year 1872 or thereabouts. Here is a legitimate chance to try on Prof. Hitchcock's conditions, to wit: Were Dr. Johnson's experiments with the 19th band published? (as were my own). Again, were they "subjected to public examination?" (as were my own). Let the Professor's rule work both ways. Meanwhile I now assert, and know whereof I affirm, that a Powell & Lealand 1-10th of 1872 cannot be forced to show the 19th band by lamplight. In general, I don't propose to accept anything done with the 19th band five years ago, as comparable with what is being done in 1877. Again, all who have seen the 19th band as displayed with the duplex and modified Beck illuminator, instantly admit that for wondrous delicacy of definition, the total absence of the "ghost" of a diffraction line, all other methods of illumination (by artificial light) are simply "nowhere." And further, that any *attempt* at photographing these wonderful lines has been but approximative. To be more definite, the best photograph of the 19th band yet made is simply a caricature. Nevertheless it is wonderful that Col. Woodward has succeeded as well as he has, and his photographs are the best that I have seen.

A word as to the mathematical tables. There can be no possible objection to these, *when* (its my chance to say "when" now) they agree with *obvious facts;* they *are* objectionable when they are not in accord with facts. I stand ready to accept truth in any form; ditto to repel error. Now the facts are, that from a mathematical standpoint the limits of vision have been erroneously "set" again and again. I simply protest against fighting *facts* with mathematics—simply this, and nothing more.

In drawing towards the close of this article, I desire, as *apropos* to the question at issue to state a little bit of personal experience, viz: About a year ago, a gentleman, a professor occupying a responsible position, gave me a *carte blanche* to provide him with a medium power lens. He was particular to state that he was engaged in histological studies, and wanted the glass for such and similar purposes. In response, he was furnished with a 1-6th duplex. Last summer he visited me during his vacation, and became my pupil. He was, of course, an apt scholar, and quick to learn. He spent with me weeks in acquiring the manipulations of this glass, and became quite expert. When he left me he said, "I have now learned *practically* what was done for me in the selection of the objective, which I now prize more than ever, and it is astonishing *how much* is due to the handling. I had no idea of it." A few weeks ago he wrote me that he was doing finely with the duplex, and had succeeded with it in tracing structure (histological) that could not possibly have been seen with any low-angled glass. Further, that the very best makes of the low angles were constantly within his reach.

Now it is a fact that before I furnished this gentleman with the duplex, he was as fully committed in favor of low angles as Prof. Hitchcock can be; but unlike Prof. H., he commenced the study of the high apertures, and with the sure results above narrated. His address will be furnished to any one desiring it.

Prof. Hitchcock says something (I quote from memory) about "accepting defeat in a becoming manner." I desire most earnestly to advertise the fact that it is not, has not, been any part of my purpose to "defeat" Prof. Hitchcock, and as I have understood the gentleman from the very onset, he is not, nor has he been, in a position to suffer defeat. He simply wants the facts, and I have endeavored to furnish them, and if so be that any good has been brought about by this discussion, your readers are quite as much indebted to Prof. Hitchcock as to any one else.

In conclusion, I return Prof. Hitchcock my sincere thanks for the courteous and gentlemanly consideration he has ever extended me. It has been my intention to reciprocate, and with the hope that I have been in a measure successful, and with the kindest feeling towards Prof. Hitchcock, to you Mr. Editor, and to your many readers, I remain sincerely yours,

J. Edwards Smith,
Professor Histology and Microscopy.
Homœopathic Hospital College, Cleveland, O.,
December, 1877.

Note.—In your October number, page 132, an obvious error occurs. For "what was known as a high-angled 1-10th of 180° ten years ago," read "130° ten years ago," etc.

J. E. S.

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Eighths and Tenths vs. Fiftieths.

Ed. Am. Jour. Microscopy—Referring to the paper read by Mr. H. C. Hyde at the regular meeting of the San Francisco Microscopical Society, on the evening of Dec. 6, I find it stated that the details of the search made by Messrs. Drysdale and Dallinger, in their investigations on the life-history of monads, "were only successfully compassed by the use of the 1-25th and 1-50th object glasses of Powell & Lealand, with eye-pieces giving powers from 2,500 to 5,000 diameters."

Now the official reports of Messrs. Dallinger & Drysdale (see the London *Monthly Microscopical Journal*) expressly state that the most difficult portions of their labors were only accomplished by the use of a Powell & Lealand new 1-8th, and that with this new glass they succeeded in demonstrating structure, which had totally defeated the 1-50th.

It is a wonder that Mr. Hyde, whom we all know as a talented gentleman and a close observer, should thus have got things mixed.

Doubtless he will not object to the above correction.

Those who consult the London *Microscopical Journal* will find, too, that Messrs. Dallinger and Drysdale further assert that with the new Powell & Lealand 1-8th they also saw *Amphipleura Pellucida* resolved into dots. Further, by consulting the old files of said journal, it will become apparent that I announced *three years* previously, in the said *Monthly Microscopical Journal* that I then and thus saw *A. Pellucida*, using a Tolles three-system 1-10th, made for me in 1869.

The above facts are significant. First, Messrs. Dallinger and Drysdale fully sustain the position which I had, almost single handed, taken, and have maintained in every instance where comparisons could be made "conjointly over the tube," to wit, that the very best results are to be had with high-angled glasses of medium focal lengths. Secondly, that it is quite unnecessary for Americans to go or send abroad for as fine object-glasses as are made.

By the way, Mr. Editor, that San Francisco Society is a live institution. Would that we had more just such. J. EDWARDS SMITH.

Homœopathic Hospital College, Cleveland, O., December, 1877.

[We believe that Messrs. Drysdale and Dallinger also saw the same structure, which was invisible under the 1-50th, by a 1-10th of Tolles. We have given a general statement of the present views of our best microscopists on this subject in the new edition of our little book, "Practical Hints on the use of the Microscope," page 90. The paper by Mr. Hyde did not accompany the report sent us by Mr. Kinne, and so we are unable to publish it. The enlarged space now at our command will enable us to do full justice to all papers and reports, and we hope that the secretaries of our different societies will promptly forward them. —ED. AM. JOUR. MIC.]

A Correction.

Ed. Am. Jour. Microscopy—Permit me to correct an error into which Prof. J. E. Smith has fallen, in his letter in your December number, in reference to the scale on body and vernier on limb of microscope.

Prof. Smith has been misinformed; "the President of the Dunkirk society" did *not* "adopt Mr. Fell's plan," but devised it himself, as a part of the plan of a new microscope stand, which he has had constructed for him by Mr. Tolles. The object held steadily in view in the designing and construction of this stand being to produce an instrument, which, while combining the highest qualities desirable for ordinary work, should also, without unnecessary complication, provide means for the study of the optical qualities and properties of eyepieces and objectives.

The object of the scale and vernier device is to determine readily the working distance (anterior conjugate focus) of objectives, from which to calculate their angular aperture by Wenham's triangle method, for comparison with the results of other methods, and grew naturally out of certain studies upon angular aperture. In practice it has proved useful for this and other purposes.

GEO. E. BLACKHAM.

Dunkirk, N. Y., Dec. 20, 1877.

Lactic Ferment.

Ed. Am. Jour. Microscopy—It seems almost a hopeless task to undertake the correction of the numerous errors and misstatements occurring in the various magazines and papers in regard to fungi, and the writer usually leaves it to those more competent than himself. But a very remarkable statement occurs in the article "The Brewer's Microscope," (taken from the *English Mechanic*) in your Oct. number, which he regrets to see circulated among the microscopists of the United States without correction.

The writer of that article speaks of the lactic ferment, Penicillium glaucum. Now the lactic ferment is quite different from the common blue mould known as P. glaucum, or more correctly P. crustaceum, and was described as early as 1857 by Pasteur, who first demonstrated its nature, and who says that "its examination with the microscope scarcely enables us to distinguish it." The description given a few lines below is very good, in fact the very same words can be found on page 199 of Schutzenberger's popular work on fermentation.

In almost the next sentence he describes it as "a long eel-like organism, tossing aside any yeast globules with which it may come in contact." The writer has frequently seen them, both near and in contact with yeast and milk globules, and never saw any such performance, and from the disparity in size, would as soon expect to see a rat toss a terrier.

A little further on he says: "A person once familiar with this organism soon detects numbers of them," which, considered in connection with the preceding assertion, and the copied description, leads one to infer that the party's studies have been from the books, to the neglect of his microscope, for to be seen they must be looked for carefully, and with a high power.

To return to Penicillium. It is a well-known fact that the spores of this and other moulds have the power of exciting alcoholic fermentation when growing *submerged* in saccharine solutions, and it has been asserted by two eminent mycologists (Berkeley and Hoffmann) that yeast is nothing else but an imperfectly developed penicillium. While this is not generally admitted, it is true that the peculiar growth of the submerged mould is hardly to be distinguished from true yeast by a microscopical examination.

The writer of this has not the slightest practical knowledge of brewing, or any doubt of the general correctness of the article, but having in times past lost many hours of precious time, and experienced grievous disappointments, from just such little misstatements, writes to save others from the same experience.

Chicago, Nov. 5, 1877. E. B. STUART.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of Dec. 21, Mr. J. D. Hyatt, President, in the chair.

The Curator reported some valuable donations of material for distribution among the members, which included some beautifully cleaned chalk foraminifera, polycystina from Barbadoes, and spicules of Gorgonia from Florida. There were also other donations, and the Secretary presented a page of the Chicago "Times," which contained a characteristic article from the pen of Dr. R. U. Piper, of Chicago, who seems to delight in the notoriety obtained through sensational newspaper advertising. This contribution has no scientific value, but serves to show how a writer can abuse his subject, either intentionally or from insufficient knowledge.

Mr. Phin presented a file of the AMERICAN JOURNAL OF MICROSCOPY.

At this meeting the constitution and by-laws, which have been under discussion for some time were finally adopted.

Several gentlemen were proposed for membership, and their names referred to the proper committee.

A paper was read by the Secretary—subject, "A New Rhizopod," which appears in another column.

After adjournment there was an interesting and instructive conversazione. The Librarian and Curator, Mr. D. B. Scott, gave a practical illustration of his method of mounting Gorgonia spicules and foraminifera; and Mr. Wall exhibited some of his stainings of vegetable tissues, which were very fine.

The society promises to be of much value to its members, and as the work of organization is now completed, regular reports of its transactions will be published in this journal. Meetings are held on the first and third Fridays of every month. Mr. A. J. Swan, of 176 William street, New York, is the Corresponding Secretary.

R. HITCHCOCK, Recording Secretary.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, November 1st, and after the reading of the minutes of the previous meeting, Prof. F. L. Bardeen, of Ann Arbor, Mich., was elected a corresponding member of the Society.

To the library, there was added by purchase, "Atlas of Human Anatomy and Physiology," Turner & Goodsir; and by subscription there were received the AMERICAN JOURNAL OF MICROSCOPY, "Cincinnati Medical News," "Quarterly Journal of Microscopy," and "Monthly Microscopical Journal," for October, "Nature," for September, "Popular Science Monthly," and Supplement, for November.

Under the head of reports of committees, Mr. Henry Edwards stated that the so-called "jumping beans" from Mexico, which had been handed him at a previous meeting, had developed a beautiful moth, of the family Tortricidæ, and he would soon be able to report as to whether it was a new species, which he thought very probable. He stated further that this proved to be one of the few instances in which the lepidoptera encroached on the vested rights of the coleoptera in the way of piercing the seed capsules with their ovipositors and laying an egg which, when hatched, destroyed the seed, as the curculio and kindred insects are wont to do.

Mr. Wm. Lighton, of Ottumwa, Iowa, sent the Society a diagram of a piece of apparatus he had devised for the purpose of getting perfectly parallel rays for the illumination of objects mounted in fluid or balsam, when viewed with high-power immersion lenses, of large angular aperture. With the diagram the method of using the device is at once clear, and, perhaps, without it the reader may understand when we say that the upper surface of a right-angled prism is made to form an immersion contact with the under side of a slide, being adjusted and held in place by suitable fittings, small enough to pass through a well-hole in the stage. The back of prism forms an angle of 90° with upper surface, and is the reflecting surface, while the face of prism or subtending surface, forms an angle of 45° to reflecting surface. It is essential that the whole be fitted into a box, covering all surfaces except the upper or contact face, the light being admitted through a small aperture, about 1-16 of an inch in diameter, in the covering to the face of prism. Mr. Lighton states that he finds this accessory of special use to him, and its effects upon the diatomaceæ surpasses any of the modes of illumination he has ever tried.

Mr. J. P. Moore furnished the Society with the following technical description of two new funguses, with remarks concerning them. The Tremella he speaks of might be cultivated and cut up into steaks for a good sized family, which would be an object these hard times. Messrs. Moore & Bigelow seem to have eaten it, enjoyed it and both live.

AGARICUS (PLEUROTUS) NEMOROSUS. (N. SP.)

Pileus—At first slightly campanulate, then in age, expanded and slightly depressed at centre; cuticle thick, separable, pale yellow, and broken up into deep angular scales, which in many cases overlap each other; edge incurved; flesh thick and solid, nearly white, not changing in drying; hymenophorum confluent and homogeneous with stem.

Gills—Crowded, deep, coriaceous, adnate or slightly decurrent, much lacinate, pale straw-colored, and at the edge quite farinaceous, giving a pure white color.

Stem—Eccentric, firm, solid, tapering downward; upper portion slightly striate; dingy white; 4-6′ high; rooting cuticle separating.

This fungus grows mostly on dry, exposed, rocky hillsides, among sage brush, Gold Hill, Nevada. Pileus from 3-4′ broad, and readily recognized by its very deep areæ or scales, into which it breaks up. It has a marked and agreeable odor of decaying wood. Taste sweetish, resembling liquorice. The whole plant, on drying, retains its color and becomes very hard, almost of a woody texture.

TREMELLA FRONDOSA—FR.

"Cæspitose, very large, even, pallid yellow, base plicate, lobes gyroso-undulate."

The above is the description as given by Fries. The specimen which I have was presented to me by Mr. H. H. Bigelow, an enthusiastic collector of fungi. Its size is about 2 feet by 18 inches, and from 6 to 8 inches thick. When young it is of a pinkish yellow. Its taste and smell are both agreeable. I do not find that the Tremellini are put down as edible, but, on trial, I find that this makes an excellent and savory dish when young. No injurious effects were perceptible. There seems to be, however, a slightly exhilarating tendency to it. I wish that those who have experimented with this order would give us their results. J. P. MOORE.

President Ashburner read a very interesting paper, being a translation, by him, of an essay on the subject, "What is a Diatom?" by Mons. Julien Deby, taken from the "Proceedings of the Belgian Microscopical Society," and, were it not for its great length, would find a place in our columns. The paper was illustrated by drawings on the blackboard, by Mr. Kinne, and was a careful resumé of all that is known of the life and history of these wonderful forms of vegetable life, as ascertained by the investigations of Mr. Deby, and which confirmed the researches of such distinguished contemporaneous diatomists as Thwaite, Wallich, Hofmeister, McDonald, Wm. Smith, Pfitzer and H. L. Smith. Aside from the elaborate description of the parts of the diatom, and their method of reduplication and conjugation, which was listened to with great interest by all present, the following general remarks are published, as they may give rise to more extended thought and study of these truly wonderful organisms:

"The little microscopic organisms, of which we propose to say a few words, are distinguished from uni-cellular algæ properly so-called, as infusoria are distinguished from rhizopods, by certain well-marked characteristics. They form one of the numerous links which exist between what we are still disposed to call empirically the animal and vegetable kingdoms; great divisions which are only separated from one another by the traditions we have inherited from the first fathers of science, when the study of anatomy, histology, physiology and morphology did not exist, and when philosophical ideas of life were only presented as a nebulous veil, the corners of which have only very recently been raised by the aid of the microscope.

"The only connection between the surrounding and nourishing liquid in which the diatoms live, exists in the circumference, so to speak, of the connectives, (between the valves of the frustule); also in certain pores, somewhat problematical, along the line of the connectives with the corresponding valves, and always in the form of lineal jointings, which are only visible by means of our most powerful modern objectives. Neither pores or openings are probably ever found in the frustules of diatoms, notwithstanding the assertions of certain microscopists. Neither does solid matter ever penetrate from the exterior into the interior of living diatoms; they drink, but they do not eat.

"The curious active movements of certain diatoms always occur in an obvious manner, the principle of which is, however, obscure, by a vital action along the joinings mentioned. This is so true that if, owing to any cause, a frustule is stopped in its course by an insurmountable object, the translating force is immediately seen to be converted into another, which causes all the small bodies about it, which are floating in the water, to move backward and forward with great rapidity.

"We believe that diatoms possess other means of reproduction beside that of conjugation, but the life history of these minute beings is too imperfect for us to venture any hypothesis in this direction. The modern appearance of species where none existed before; their periodical succession, year after year, at definite seasons, without being able to find any in the interval in the same locality, give rise to the possibility of a mode of generation, which is as yet only suspected, by means of germs—by micro or macro zoöspores, and perhaps, in the first instance, with the formation of zygozoöspores, as occurs in the case of living algæ of the lower orders and situated under the same conditions as the diatoms.

"We foreshadow here a most interesting field of study, and one which is almost new to the naturalist provided with a good microscope, and possessing the time and patience necessary for this kind of study; and we think we can say with confidence that whoever will follow with care the entire life-history of a single diatom, no matter how common the species, will render a greater service to science than by describing and drawing hundreds of the silicеous frustules from the four quarters of the globe."

The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, December 6, with Vice-President Hyde in the chair. In addition to a good attendance of members, Mr. George T. Folsom was present as a visitor.

To the library was added the "Popular Science Monthly," and Supplement, for December; the Cincinnati "Medical News," for November, and Hassall's "Microscopic Anatomy of the Human Body."

Five specimens of marine formations were received from the California State Geological Society, obtained at Port Halford, San Luis Obispo county, Cal.; and Mr. C. C. Merriman, of Rochester, N. Y., donated three slides mounted by him with Foraminifera, Sections of Spines of Echinus and Selected Shells of Foraminifera, all from the Bermuda Islands. They were found on examination to be fine objects, well mounted, and the one of Foraminifera, opaque in balsam, possessed some novel features, and brought out characteristics which might prove still more fruitful with other objects that would bear balsam. Mr. Allen Y. Moore, now residing at San Diego, presented a beautiful preparation of crystals of silver, mounted by him in the same method.

A communication from Frederick Brooks, Chairman of the Metric Committee, was received, accompanied by the memorial presented to Congress regarding the adoption of the metric system as the only legal standard, after some date to be fixed by Congress, favorable action on which had been taken by the San Francisco Microscopical Society with other organizations, some time since.

Quite a feature of the evening was the exhibition by the Vice-President of one of Zentmayer's American Centennial Stands, which was designed and constructed expressly for the Centennial Exhibition. It was a beauty in every respect, and fitted with all the modern appliances for reliable and accurate microscopic work. In addition to the parts essential to all first-class binocular instruments, there were some noticeable features which will bear a full description, and recommend themselves to those familiar with the needs of such a stand. The swinging sub-stage, which carries the condenser or other illuminating apparatus, and the mirror, swings around a pivot, of which the axis passes through the object, which is in every position in the focus of illumination. The stage may be detached almost instantly and replaced by one especially constructed for extreme oblique illumination, called a Diatom Stage, and the swinging illuminator may be used for illumination from above. The sub-stage is provided with a graduated circle for indicating the degree of obliquity, and the diatom stage bears the finger marks of some of Prof. J. Edwards Smith's recommendations, and with which he has done such excellent work in the resolution of test objects.

The fine adjustment is removed to the more stable part of the instrument, and is arranged so as not to change the relative distance of objective, binocular prism and eye-piece. Among other improvements is what may be termed a "safety attachment," by means of which the highest powers may be used on the most delicate slides, the value of which is well understood by all who use high powers. This is accomplished by means of double springs in the nose-piece, which may be graduated to exactly neutralize the weight of the object-glass, so that the slightest contact with the slide sends it up and calls the attention of the observer to the fact. This is an improvement well worthy of imitation. The whole instrument places Mr. Zentmayer in the front rank of manufacturers, including the best of English and Continental makers, if not setting him before them all.

Mr. J. P. Moore was expected to be present, with a paper on "The Edible Fungi of the Coast," but illness prevented. Mr. Hyde's paper, however, which was not listened to at the previous meeting, for similar reasons, filled the gap admirably, bearing as it did on the investigations made in so important a subject as spontaneous generation.

Dunkirk (N. Y.) Microscopical Society.—A regular meeting of this society was held Dec. 14, 1877, Geo. E. Blackham, M. D., President, in the chair.

A paper by L. M. Willis, M. D., of Boston, Mass., descriptive of a new and cheap form of Heliostat, constructed from a marine clock, was read, and a photograph of the instrument was exhibited. The instrument appears to have the merits of simplicity and cheapness, and is stated by Dr. Willis to be efficient for all ordinary purposes. It can be made, with the aid of any good watchmaker, at a cost of from $25 to $30.

The president described and presented for examination a new first-class microscope constructed for him by R. B. Tolles, of Boston, Mass., which combines several new and valuable features, with great strength, solidity, elegance and perfection of workmanship. Among the novel points are a simple device for taking the focal length and working distance of objectives, and a new method of obtaining oblique illumination, and of reading off the degree of obliquity. The stage is circular, and rotates in the optical axis of the body so truly that an entire revolution may be made without sensibly decentering the object, even when so high a power as two thousand diameters is used. The additions to the library and cabinet were: "Journal de Micrographie," for September and October; Cincinnati "Medical News," for October and November; "Science Observer," for October and November; and a package of diatomaceous earth.

State Microscopical Society of Illinois.—A regular meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, Nov. 23d, 1877, Vice-President Dr. Lester Curtis in the chair. The minutes of the last meeting were read and approved. Donations reported, one box diatomaceous earth, not accompanied by any letter, and therefore not known by whom sent; the material was distributed among the members. Seven names were proposed for active membership; referred to the trustees. No further routine business coming before the meeting, it was adjourned to listen to an admirable paper on "Desmids," read by Prof. E. S. Bastin, of the University of Chicago, and chairman of the Botanical Section of the State Microscopical Society. The paper was of a purely scientific character, and of great interest to the biologist. The Professor used the black-board, and afterwards the sciopticon to illustrate his already clearly explained ideas, as to the conjugation and propagation of the minute plants.

At the close of the paper the members spent some time in discussing the subject and examining many different forms of desmids under the microscopes.

Attention was called to a mechanical finger invented by Prof. E. B. Stuart, of Chicago. It is simple in the extreme, and yet fills all the requirements of the microscopist fully as well as the more costly and complicated ones heretofore used.

The members have cause to congratulate themselves in the renewed interest shown in the society; revivals have been in order in Chicago ever since Brother Moody commenced his work here a year ago, and in no other body has it been more strongly marked than in this society; regular meetings of the society are held once a month, while the Botanical and Zoological sections meet alternately on Thursday evenings, and the Histological section the third Tuesday of each month. These sectional meetings are of great interest and are well attended.

Microscopical Exhibition.—That the public interest in the microscope and its wonders is rapidly increasing, we are daily receiving evidence. Hitherto those who have not given special attention to this subject have derived their ideas from the wonders shown by sidewalk exhibitors, whose stock consisted chiefly of eels in paste, a drop of water filled with creatures visible to the naked eye, a flea, and similar "horrors," and whose explanations were anything but clear and accurate. On several occasions lately the microscope has formed a prominent feature in the attractions of "fairs" and exhibitions. At the Loan Exhibition at Dr. Cuyler's Church, in Brooklyn, the exhibit was very fine, and proved immensely attractive. Perhaps the most extensive and thoroughly organized was that exhibited at the Fair for the Benefit of the Ladies' Hospital at Paterson, N. J. This was managed by one person, without any trained assistance, and the conditions requisite to insure success were peculiar and worth noting.

It was, of course, necessary to exhibit several objects to each individual, and there being but one exhibitor, all thought of changing the objects or of giving verbal explanations had to be abandoned. Some fifteen objects therefore were selected, and microscopes adapted to exhibit them were procured. The objects were chosen for interest, beauty and instructiveness, and were arranged in a series in which they logically followed each other. Magnifying power was illustrated by photographs of printed matter, and by Webb's wonderfully fine writing, the object shown in this case being the Lord's Prayer, written at such a rate that if the whole Bible were written in letters of the same size, it could be written on one side of a postal card, and leave considerable space to spare. Next followed a slide of Dalton's exquisitely arranged insect scales, after which came several interesting natural objects, the series closing with the circulation of the blood in the foot of the frog. Full descriptions of all these objects were printed on a neat circular, so that every one could read it at his leisure. In this way all changing and arranging of objects were avoided, and no explanations were necessary.

Although there was an extra charge, the room was crowded every night, but it is safe to say that the instruction afforded, and the interest awakened in the subject were of even greater value than the amount thus contributed to the funds of a worthy object.

We may note that although all the objects exhibited were of the most beautiful and interesting character, with two exceptions none of the powers used exceeded eighty diameters.

The success of these exhibitions proves not only that ordinary microscopes of low power are capable of exhibiting a great deal that is interesting and instructive and new to the public generally, but that wherever a few earnest microscopists are to be found, an important attraction may be added to many of our public gatherings.

Current Notes.

Please Explain.—The learned editor of the "Medical Record," in a very complimentary review of our little book on the microscope (for which review, by the way, we would here make all due acknowledgments) tells his readers that it will save many beginners in microscopy from a violation of the *seventh* commandment. We fail to understand how. Will the editor have the kindness to enlighten our ignorance?

A New "Safety" Mounting.—Safety stages have long been in use, but Dr. Edmunds exhibited at a recent meeting of the Quekett Club a new kind of safety mounting. The object is mounted be tween two pieces of thin glass, which are fastened over a hole cut in the thinnest bank-post paper. This paper is then fastened, by gum or otherwise, over a large hole in a wooden slide. The thinness of the paper and glass enables the object to be viewed with a high power from either side, while the elasticity of the paper is sufficient to secure both the object and the objective from fracture, if they should be accidentally brought into contact.

An Excellent Idea.—The Quekett Microscopical Club has adopted a capital idea, and one which will no doubt largely increase their usefulness and the subsequent interest of their meetings. It has been arranged that one of the members, Mr. Ingpen, should occupy one of the bays in the room in which they meet, and give to any who feel disposed to attend, a short description of the microscope and its construction. A series of such explanations cannot fail to prove of much use to many of the younger members of the club, and they may be given without in any way interfering with the freedom of the general body of members during the evening.

We gather further from the report that the club has certain "gossip" nights, in which, we presume, the discussions are of a somewhat desultory character, and it is on these evenings only that the feature we have described is introduced. The New York Microscopical Society have, as elsewhere intimated, adopted a similar idea. In this case, however, the instruction is not of an elementary character, but is confined chiefly to special methods of working. These "demonstrations" are given after the regular business of the evening has been concluded.

A New Journal of Natural History.—With the announcement that the "Monthly Microscopical Journal" (London) will no longer be published, comes the prospectus of a new journal of Natural History and the allied sciences. It will be the organ of the Midland (England) Union of Natural History Societies, and will be called "The Midland Naturalist." It will be of demy 8vo. size, and will contain original articles, local notes of meteorological and other observations, reports of the meetings of the societies of the Union, correspondents' column, and as complete a diary of the meetings and excursions of the societies as possible. It will be issued monthly, price six shillings sterling per annum. Messrs. Hardwicke & Bogue will be the publishers.

Trichinosis in Leipsic.—A mild epidemic of trichinosis broke out a short time ago in Leipsic. The disease, according to the official statement, has been traced to Brunswick "mettwurst," a kind of pork sausage. The epidemic has attacked chiefly the upper classes, the families of several professors being affected. Among others, a young medical professor has been attacked, but fortunately his attack is a slight one. The authorities have been urged tq seize the pretty large stock of the diseased sausage that is still on hand in the city, in order to prevent the further spread of the epidemic.—*Medical Record.*

[It is strange that a medical professor, even though young, should have ventured to eat pork that was not thoroughly cooked. Thorough cooking will, in every case, destroy all trichina present in any meat.—ED. AM. JOUR. MIC.]

A Good Paste.—A correspondent of the *Druggist's Circular*, in reply to a request for "a good cheap paste that will not ferment in warm weather, and which contains no poisonous substance," submits the following, which makes a paste similar to that used on postage-stamps and gummed labels, and vastly superior to tragacanth, acacia, or flour paste for ordinary use: Dextrine, 2 ounces; acetic acid and alcohol, of each, 4 drachms; water, 2½ ounces. Mix the dextrine, acetic acid, and water, stirring until they are thoroughly mixed; then add the alcohol.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Slides of black rust on wheat stalk, opaque and transparent; stained fertile frond of Adiantum pedatum, etc., for other mounted objects. Address F. H., Drawer 85, Cherokee, Iowa.

Slides of spores of botrychium, and fossil diatoms from Bow, N. H., for other mounted objects. Lists exchanged. Wm. W. Griffin, Lynn, Mass.

Slides of cuticle of larva of Macrosila Carolina, showing crystals, in exchange for other objects. E. A. Burdick, Pension Office, Washington, D. C.

Palates of mollusca, a great variety, mounted or unmounted, in exchange for mounted slides of interesting objects or good material. C. M. Vorce, 164 Lake street, Cleveland, Ohio.

Case of algæ, and live fresh water animalculæ, for any well-mounted specimen. Send slides to A. Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of Arachnoidiscus Ehrenbergii, *in situ*, on seaweed from Santa Cruz, Cal., and Aulacodiscus Kittoni (transparent), for other mounted objects. C. Mason Kinne, No. 422 California street, San Francisco, Cal.

Mounts of Uric Acid (natural urinary deposits) in exchange for other mounted objects of interest. Address W. J. Weeks, Homœopathic Hospital College, Cleveland, Ohio.

Specimens of the marbles, granites and minerals of Vermont, in exchange for Western minerals, or good fossils; minerals and fossil woods from the far West specially desired. Dr. Hiram A. Cutting, State Geologist, Lunenburgh, Essex county, Vt.

Slides of various kinds of fertile fern fronds, Indian corn, deutzia, citra odora and other leaves, decolorized and stained, exchanged for other good microscopic objects. C. Blasdale, M. D., Jericho, Queens County, N. Y.

Publisher's Department.

Free! Leisure Hours, a splendid 16-page family literary paper, full of choice stories, sketches, poetry, etc., sent three months, with a pair of beautiful 6 by 8 chromos, worthy to adorn the walls of any home, free to any one sending fifteen cents (stamps taken) to pay mailing expenses. The publishers, J. L. Patten & Co., 162 William street, New York, guarantee every one double value of money sent. $1,500 in prizes, and big pay, given to agents. A rare chance to make money.

Curious and Valuable Books.—We are in receipt of a catalogue of books issued by Mr. Evans, of 21 Park Row, New York, in which we find a good many items of interest. Mr. Evans has a large stock, and as his prices are quite reasonable, even for these times, our friends who visit New York would do well to call on him. Those at a distance will find his catalogue worth sending for.

First Impressions.—However worthy any man may be, the character of the first impression which he makes is always largely due to his dress. Hence the importance of dealing with a man of taste and judgment when we stand in need of a renewal of our garments. Mr. Temple, of 152 Fulton street, seems to have acquired the art of combining taste with economy, as we and several of our friends know by experience.

Meerschaum Pipes.—Whatever difference of opinion may exist in regard to smoking, there is no doubt that no more welcome present can be made to a friend who smokes than a handsome meerschaum pipe or cigar-holder. It has long been acknowledged that Kaldenberg, of 125 Fulton street, New York, holds the first place as a manufacturer of meerschaum and amber goods. His exhibits at our fairs have always been centres of attraction to lovers of artistic work—even to those who, like ourselves, do not use the weed.

Popular Lectures.—The lecture committees of the various literary associations throughout the country who are anxious to make their courses *pay* will be glad to learn that the well known founder of "Moore's Rural New-Yorker" is open for engagements. Mr. Moore's name is a household word wherever agricultural or family literature is known, and from his large experience, his pleasant way of telling what he knows, and his thorough knowledge of men and things, we feel certain that where he is invited once, the invitation will be repeated. Letters addressed to him at "New York," will readily find him. His name is too well known to require further localization.

The Study of Botany.—Very many of our readers would no doubt like to undertake the study of systematic and structural Botany, but are deterred by the difficulty of making a beginning, and the fact that no teacher is accessible. We are glad to see that Miss K. Parsons, who has been for some time connected with the classes for Home Study, has undertaken to teach botany by correspondence. She has had much experience in this method of teaching, and in this particular science has herself studied for many years in the summer classes at Harvard College. She refers by permission to Prof. Asa Gray and Prof. G. L. Goodale, of Harvard College, and we trust that large numbers will avail themselves of her assistance. For terms and other information apply to her address, 54 Garden street, Cambridge, Mass.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, FEBRUARY, 1878. No. 2.

Rivet's Microtome and its Use.

BY DR. JOHANNES GRÖNLAND.

Translated from the "Zeitschrift für Microskopie."

SINCE man has been engaged in microscopical observations, he has endeavored to contrive cutting instruments suited to the preparation of microscopical objects, and therefore it is long since he first contrived apparatus by means of which very thin, but uniform sections of the object to be observed, can be made.

By means of the simple knife, and the different constructions of the double knife, it was only possible to obtain very thin uniform cuts of comparatively small area. An attempt was therefore made to contrive instruments, which, by means of suitable mechanism, would give greater firmness to the knife, and secure a more uniform section. Such instruments are known as microtomes or section-cutters. That the endeavors to construct a microtome are already of ancient date, is a well-known fact. One of the oldest instruments of this kind appears to be that in the Utrecht physical cabinet. Since that time a great many different microtomes have been constructed, which have more or less completely satisfied the demands made upon them. The objection, however, which has been made, not entirely without reason, to most of these instruments, is this, that although very complex, their performance in many cases has not been equal to the requirements of rigorous science, and consequently they have not received much favor from specialists in natural science.

Nevertheless, it seems to us that those who regard the microtome as a *pons asinorum*, damaging to true science, and only furthering superficiality and so-called scientific diletanteism, take a one-sided and prejudiced view of the matter.

It is not the object of these lines to give a review and critical discussion of all known microtomes. The writer of these lines has not had occasion to learn, from practical experience, their advantages or defects, and he does not consider himself competent, without such experience, to pass judgment upon them. But having used the instrument described below exclusively for making plant preparations, he may be permitted to express in a few words his opinion in regard to the demands required of such an instrument, and to give a somewhat more exhaustive account of a microtome which he has already used for a number of years with good results, and make known its advantages.

As regards the features essential to a good microtome, I agree in the main with the views of P. Schiefferdecker. In how far the instrument devised by him corresponds with these, I cannot judge, for I have not had an opportunity to see such a one, or to work with it. The most important feature of a microtome appears to me to be the simplicity of its construction and at the same time its cheapness, and in these respects an instrument used by me for years, and in no wise new, but, as it appears to me, again and again mistaken for another, and with injustice defamed, may stand at the head. It has not profited, in my opinion, by any of the supposed improvements which have been attempted upon it. I refer to the microtome, made of wood, devised in the year 1868 by my friend Rivet, of Paris. The number of sections I have made with it since it has been in my possession, and of which not a small portion have come into the hands of expert specialists, amounts now to thousands, and this circumstance suffices to show that the statement of Herr Alexander Brandt, that in Leucard's zoological laboratory, wood had proved to be a poor material for such an instrument, is unfounded. It is certainly necessary that the wood be selected to suit the instrument, but if this is done the microtome always retains its original value, presuming that it is carefully protected.

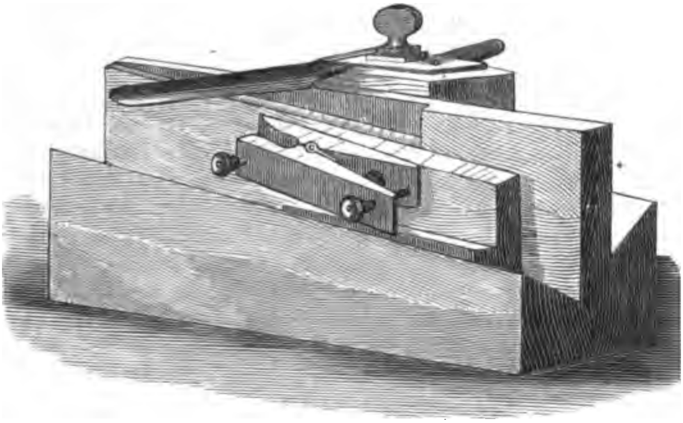

Fig. 1.

The apparent improvement, by making it of brass, instead of wood, which probably was first done by Leyser, in Leipzig, gives it greater precision. While it cannot be denied that the material is truly better suited for such precision, it should not be overlooked that thereby comes a greater clumsiness in managing the knife, which is shown irrefutably by comparative work with a wooden and a brass microtome. One errs greatly if he believes that the skill of the cutter has little or no regard to the management of the knife. P. Schiefferdecker is also of the opinion that the sliding of the knife in the human hand by a microtome is more advantageous and judicious than the complete independence of the instrument from the individual skill of the operator. If, then, with Rivet's microtome, the movement is not by the free hand, but by means of slides, it appears that the working of the lighter built wooden machine is more satisfactory than that of the one of brass. Moreover an instrument of the latter kind is much more costly than a wooden one, and from this fact alone its use will be much less general.

A circumstance which in particular effects this machine is the position and fastening of the knife. In Leyser's instrument the position and fastening of the knife appear to be the same as in the Rivet microtome, made by the mechanic Verick, in Paris.

Imitations of the Rivet microtome have also been made in Breslau after the design of Dr. R. Long, which differ in many points from the original construction.

As such an instrument lies before me, which, like Leyser's, is entirely of metal; and, as I have had occasion to compare its performances with those of Rivet's construction, I give here a detailed description of my instrument, and point out where it differs from the one made in Breslau.

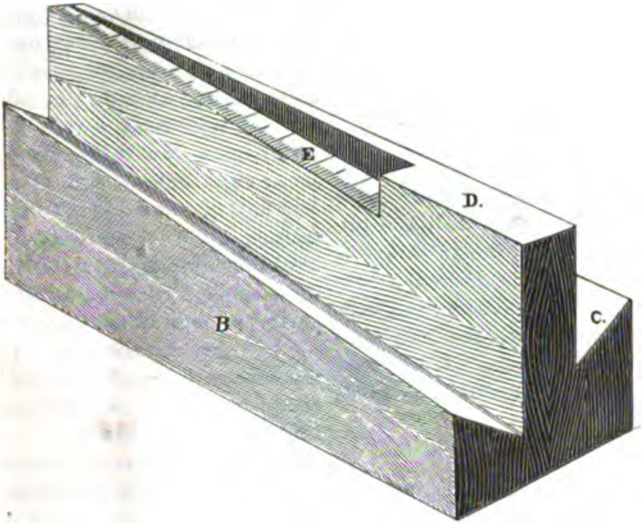

Fig. 2.

The microtome, as originally constructed by Verick, after the plan of Rivet, consists, besides the knife, of three pieces, namely, a wooden block (Fig. 2) 16 centimetres long, 6 centimetres high, and 6 centimetres broad. On either side of this block there is a wedge-shaped groove B and C, so that the breadth of the upper middle portion, D, only measures 13 millimetres. The groove, B, on the left side (when the instrument is placed before one for work), lies in a sloping plane having an inclination of 1 in 100; the right hand groove, C, on the contrary, lies more in a horizontal plane. Above, on the middle portion to the left, there is to be found running parallel with the wedge-shaped cut, a rule 10 centimetres long, divided into millimetres.

Each division corresponds to an elevation of 1-10 millimetre.

Both the wedge-shaped cuts run parallel side by side, so that the upper middle portion of the block is of uniform breadth from front to back. In the wedge-shaped groove lying in the inclined plane, an accurately fitted wooden block, F, can be moved back and forth, upon which is a clip, H, provided with a spiral spring, G, in order to confine the object to be cut directly, if it be large enough. If the object is too small, however, to be held by the clip, it is clamped between two little pieces of elder pith, or preferably, with plants, imbedded in stearine.

Fig. 3 shows the clip with the object held by it seen from above. In the wedge shaped groove, lying horizontal, is another wooden wedge movable to and fro, which projects above the middle ledge of the block about the thickness of the back of the knife. In the upper part of this there is a groove into which the strong handle of the knife is firmly pressed, and which is made with greatest care, so that the knife may maintain the most advantageous position for cutting. It can be clamped in this position by means of a brass screw, so that any change of position is quite impossible.

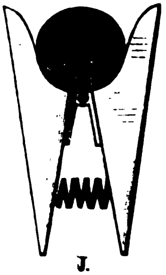

Fig. 3.

The cutting is now a very simple operation. One places the wedge with the object clamp, according to the thickness of the preparation which it is desired to obtain upon a whole or half division, and conducts the cutting by drawing the knife with a short pull towards himself. With most objects an elevation of 1-10 millimetre gives cuts sufficiently thin.

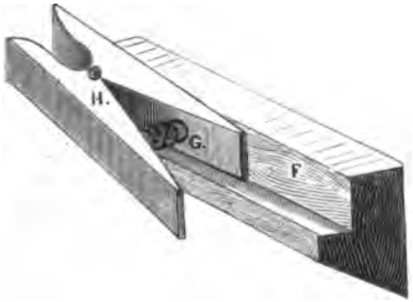

Fig. 4.

As regards the construction of the knife itself: the blade is 55 millimetres long, by 16 millimetres broad, and makes an angle of 15° with the handle, which is 80 millimetres long by 12 millimetres broad. The handle, and also the back of the knife, have the same thickness of 5 millimetres. The blade is very deeply hollowed above, but beneath ground flat, and both sides are polished. The very solid construction of the knife is, as I know from experience, of the greatest importance to its utility.

In the use of this instrument, which, I must here explicitly remark, is only suited for the cutting of objects not too hard,* I take care to pour water upon the surface of the object already prepared for this purpose, and also place a few drops of water upon the concave side of the knife. By this means the section is prevented from adhering to the blade, whereby it would be broken or torn. That the knife-blade must be of the utmost possible degree of sharpness is a *conditio sine qua non*, hardly requires mention. I do not allow the labor to deter me from carefully stroking the blade upon the razor strop after every six or eight cuts of soft, or every three or four cuts of more difficult objects. In this manner I have been able to make rather hard preparations with this instrument, as, for example, through a cereal fruit (grain of barley) a longitudinal section which showed the bud axis and the layers of young leaves, together with the albuminous bodies. Such complete sections are obviously not to be made by the free hand.

If I now compare my instrument with the Breslau microtome, the differences are to be seen at a glance, in the more costly material, and the clumsiness in making sections, particularly in the following points: The object-clamp, which in Rivet's instrument is fastened immovably on the wedge of the inclined plane—which I regard decidedly as an advantage—can here turn upon a steel peg. The reason for such turning is not evident to me. Moreover, the clamp itself, which in my instrument simply closes by the strong spiral spring provided, here is worked with two screws, the use of which appears to me very problematic, and unnecessarily complicate the apparatus. The right and left wedge-shaped cuts are not, as with me, parallel, but diverge towards the front. Any presumed advantage in this for the cutting appears to me illusory. The greatest defects appear to me, however, to cling to the knife and its manner of fastening. The blade of the knife is disproportionately long; the thickness of the back measures 4 millimetres, the length 12 centimetres, the breadth 19 millimetres. The reason for the long knife I do not comprehend, since in cutting only half of the edge can be used. The blade is only slightly concave. The handle of the knife, which is 70 millimetres long, 15 millimetres broad and 4 millimetres thick, is simply secured by means of a screw furnished with a cruciform plate, and hence lacks all firmness and immobility, features which, according to my experience, are indispensable. These special causes has rendered it impossible for me to obtain useful sections from the instrument as thus modified. Careful comparison shows indisputably *that the Rivet microtome, in its original simple form, is capable of most excellent performance, and, that the modifications undertaken upon it, without increasing its usefulness, indeed detracting from it, have made it considerably more costly.*

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*For cutting harder woods, and such like objects, I make use of a microtome of entirely different construction, on Welker's principle.

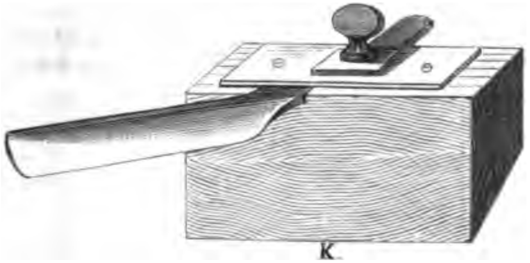

Fig. 5.

If I have permitted myself above to draw attention to the advantages of an already celebrated little instrument in its simplicity, this is because I foresee great results for the extension of microscopical observations from its more extended introduction, and because its undervaluation appeared to me truly not sufficiently justified. It is greatly to be desired that a skilful mechanic should prepare such instruments, and it is hardly to be doubted that he would find a good market for them. My judgment of the instrument is from almost daily use of it for about ten years, and I am in a position to call upon a great number of scientific men, in whose hands are to be found preparations made with it, to testify to its performance.

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Elementary Papers on Objectives and some Accessories.

BY ROMYN HITCHCOCK.

(*Continued from page* 164 *of preceding volume.*)

II.—COVER CORRECTION.

WE come now to the application of these principles to the construction of objectives. Beyond the mere elementary principles the writer will not venture, for theoretical knowledge will protect no mere statements from the attacks of the practical maker of objectives. Therefore we will keep within the limits of safety, and avoid deep water, which is often troubled.

The best objectives are generally made of three sets of lenses, designated as the front, middle and back combinations. For a long time it was not possible to construct objectives having an angular aperture even approaching what we now consider as low angles, because opticians were unfamiliar with certain properties of achromatic lenses, which were first discovered by Mr. J. J. Lister about the year 1829. Immediately following the announcement of Mr. Lister's results, there came about a very radical change in this regard. It is our purpose to describe the results of these investigations in as concise language as possible, for, it is a curious fact that, in spite of their great importance, they are scarcely mentioned in works on the microscope, and are even passed over entirely by most elementary works on general physics.

To illustrate the principal points which concern us, we will refer to Fig. 6, which represents an achromatic lens of the common form. The principal focus (or focus for parallel rays) is at the point F.* Mr. Lister discovered that from a certain point not far from the principal focus, and a little beyond it, as A, light would be transmitted by such a lens quite free from spherical aberration. The ray A *b* passes on to C quite perfectly corrected, but if the radiant point be moved, either from or towards the lens, the aberrations are again produced; if we move it farther away, the positive aberrations are in excess, if in the opposite direction the negative action preponderates. The point A is called the aplanatic focus of the lens. It may be readily understood that the action of a lens in changing the course of a ray of light varies with the direction of incidence, and with every change produced by the first lens, the opposing action of the second lens is increased or diminished. The result naturally follows that there is a point at which the two lenses will just balance each other in their aberrations, and this is what Mr. Lister first discovered.

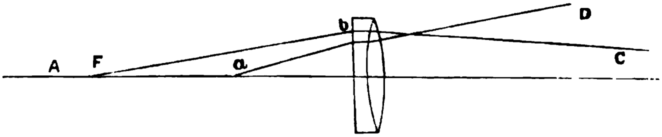

Fig. 6.

But he also found a second point within the principal focus at which the same result is seen. The point *a* is therefore known as the shorter aplanatic focus, because here also the corrections are perfect.

Between the points A and *a* the spherical aberration is negative, *i. e.* the action of the concave is more powerful than that of the convex lens. Beyond A and within *a* the aberration is positive.

The application of these facts to the construction of objectives is admirable.

For the sake of simplicity we will consider an objective made of two corrected lenses as in Fig. 7, so placed that the rays starting from the shorter aplanatic focus F'', of the first one B, enters the second one from the direction of its longer aplanatic focus F. We can readily see that under these circumstances the radiant point may be moved back and forth within certain limits without destroying the corrections; for, suppose the point F'' to approach the face of the lens, it passes within the aplanatic focus of the first lens, and the emergent rays have consequently positive aberration, but as they must enter the second lens from the direction of a point within its longer aplanatic focus, this lens exerts a negative action which neutralizes the opposite influence of the first one. So, in moving the point in the opposite direction the relative action of the lenses is reversed.

Practically the distance through which this point may be moved is very small in case of a microscope objective, and, since by exceeding this limit we lose the best performance of our objective, we may be able to understand one reason why an excessively long draw-tube is not advantageous for delicate work, and also why we cannot enlarge the image beyond a certain point by increasing the distance between the objective and screen, with satisfactory results, in photographing with the microscope. It need hardly be said that by increasing the length of the tube, or distance from the screen, the focal length becomes shorter, illustrating in a perfect manner the fact that magnifying power depends upon nothing else than focal length.

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*There is a mistake in the lettering of this figure. The reader is requested to move the letters A and F towards the right until A occupies the position of F. The description will then be intelligible.

In objectives with three lenses, the first lens has its aberrations corrected by the two behind it, they acting as one. The front lens at the present time is frequently a simple plano-convex lens. Such a lens must necessarily have a certain amount of positive aberration, both for color and form, and this must be corrected by the back lenses. Still it is practicable to correct much of the imperfections of such a lens by careful attention to its thickness. The principles here involved are simple, and will be discussed in a future number of this journal.

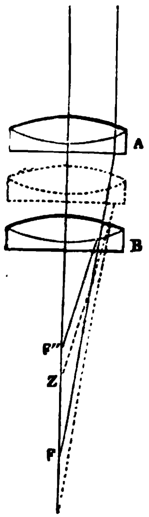

Fig. 7.

We now pass to the consideration of the aberrations introduced by the interposition of a covering glass between an objective and the object.

All microscopists are familiar with a figure like our illustration (Fig. 8) showing the action of the cover-glass G upon rays coming from the point O. Owing to the refractive action of the glass, their direction is not changed, but their position in space is changed, so that the emergent rays apparently come respectively from the points X and Y. The distance between these points represents a certain amount of spherical aberration, and as such must be corrected in some way by the objective.

To determine whether the aberration produced by the cover is positive or negative, we need only imagine it to be replaced by a convex or concave lens, and compare their action with that of the cover-glass. We see at once that it acts like a concave lens, the effect of the convex lens would be to bend the outer ray towards the perpendicular, and the point Y would then be beyond instead of within it. Hence the cover produces negative aberration, which adds to the negative aberration of the back lenses of the objective, all of which must be neutralized by the single front lens. Evidently, then, an objective must have some means by which we may vary the positive action of the front lens upon the back combinations to suit the requirements of covered and uncovered objects, and covers of different thicknesses, if we would obtain the best results from it. This is accomplished by varying the distance between the front lens and the two posterior lenses by means of a "screw collar."

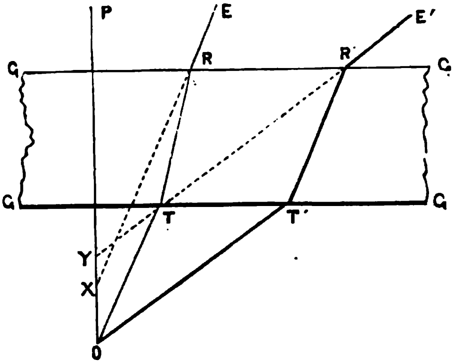

Fig. 8.

A reference to Fig. 7 indicates how this correction is made. We remember that the cover-glass and the back lens together produce an excess of negative aberration, and the problem is simply to increase the positive action of the front lens. Mr. Ross was the first to accomplish this, by causing the front lens to approach the back lens, and our Fig. 7 is taken from his original paper.

Suppose the lens A to be moved towards B, and occupy the place of the dotted lines. The rays which enter the back lens when in this position from the direction of its longer aplanatic focus, must come from some point Z. Now Z is at a greater distance from B than its shorter aplanatic focus F'', hence the rays from this point enter this lens with less divergence. We know that the less rays diverge, the more powerfully a lens bends them towards its principal axis. Consequently the rays from Z are made more nearly parallel by B than rays from F'', and the positive action of this lens upon A is increased.

A very little consideration of this point will show clearly how we may correct for the varying thickness of cover glasses. Although the principles upon which this correction is based are easily understood, it by no means follows that it is practically an easy matter to make the correction. There have been published directions for making it which may be useful at times, but the ordinary microscopist will doubtless prefer to trust to his eye alone, and correct while looking through the tube, moving the fine adjustment with one hand and the screw collar with the other. With a good medium power glass, a 1-5, *e. g.* the novice may not be able to appreciate the effect of a small change in the screw collar, but with a higher power or a wide angle glass the effect is very decided. With a power as high as a 1-16, it often happens that an object is perfectly invisible until the screw collar is adjusted to a certain point.

We hear much of "handling" objectives, and of the "knack" there is in it, but we believe it is a fact that any person blessed with good judgment and good eyesight, can, with a little experience, work any objective up to its fullest capacity. One of the essentials is very careful adjustment of the screw-collar. We do not mean to say that an ordinary worker can make one of Spencer's or Tolles' glasses *e. g.* perform as well as the maker himself, for this is hardly to be expected. Makers, constantly testing objectives, are naturally more familiar with the different effects of illumination, and are quicker to detect little defects which pass unnoticed by most of us. A man who has worked for years with central light might feel lost if called upon to resolve a diatom. What we mean is that there is nothing about such work that cannot be easily acquired by a little patience, and almost any one whose aspirations lead in this direction may attain distinction among his co-workers as a "handler."*

A few words as to the proper method of using the screw collar. Some first turn the collar, then pass the hand up to the focussing screw, then back to the collar, etc. This is a very awkward plan and a very slow one. It is always best to keep one hand on the focussing screw, the other upon the collar, and move the two together, causing the focus to follow the changes of the collar. It is stated that Mr. Tolles makes objectives in which the collar adjustment produces no change in the focus. We are not aware that Mr. Tolles himself has ever made such a claim. If he has it would be interesting to knew how this is accomplished. It seems there must be some misunderstanding about this matter on the part of certain ones who speak with authority.

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*Since this was written, these opinions, as elsewhere expressed, have been the subject of some criticism. If the writer has been inclined to undervalue the labor required to become a good "handler," he looks for his justification to the fact that so many who purchase expensive "fighting objectives," and use them well for this purpose, can do very little else. The mere exhibition of test objects, and comparison of objectives for the simple purpose of satisfying one's pride in possessing the best glass, is by no means studying microscopy for the love of the science. It is far from his intention or design to detract from the credit due to a man, who, like Prof. J. E. Smith, has secured an eminent position for himself as an authority on objectives by years of careful work.

Discursory Thoughts Relating to the Use and Abuse of the Microscope.

An address delivered by Prof. J. Edwards Smith, before the Dunkirk Microscopical Society, Tuesday evening, October 31, 1876.

To the members of the Dunkirk Microscopical Society:

GENTLEMEN—About twelve months ago a friend of mine, and a brother microscopist, ordered from London a low-angled 1-4 inch objective; my friend was engaged in histological investigations, and felt the need of a reliable medium-power glass. He had been told that wide-angled glasses, although very suitable for the purposes of the diatomist, were hardly suitable for the work he had in hand; he was told, too, that the thing needed was a glass of low or moderate angle, say from 50° to 70°, and one that had great working distance; in short, as the saying goes, he needed a good "working glass."

In due time the objective was received, and one very pleasant evening my friend called on me expressly to show the work of the lens. I remember that we had a very enjoyable time, amusing ourselves by looking over a variety of specimens suitable for the glass. In the course of the evening he exhibited a beautiful section of a human tooth, and placing the same under the 1-4th, called my attention to the "Nasmyth's membrane," described by Frey and others.

This was a matter of interest to me, for I had heard much of this "Nasmyth's membrane;" I had examined human teeth time and time again with my own wide-angled glasses, but had never been able to discover the same. I was, in fact, somewhat curious about the matter. It seemed odd, to say the least, that my glasses, which would show me, clearly and accurately, lines as close as 120,000 to the English inch, should fail to show me the existence of a membrane said to be about 1-6000 of an inch in thickness; and then again I had hunted with a low-angled 1-4th of my own without success. Hence it was with expectancy and interest that I put my eye to the tube; I saw a decided thickening of the margin of the crown of the tooth, and was informed that this was the veritable "Nasmyth." "But," said I, "is this thickened edge not the fault of the objective, and suppose that we examine the specimen with another glass?"

Removing the London lens, I substituted a wide-angled 1-6th of plus 180° of aperture, and on adjusting carefully to the thickness of covering glass, I soon had a splendid view of the preparation, by far finer than that shown by the London glass; and as I had supposed would be the case, I now had a nice clean edge in the place of the thickened one before mentioned. The superiority of the definition over that of the 1-4th was apparent; and the capacity of the 1-6th to bear the 1-4th inch solid eyepiece and amplifier—thus carrying the amplification up to nearly 4,000 diameters—was in a few moments demonstrated, but the Nasmyth's membrane was not to be seen under any amplification.

At this time it occurred to me that I might possibly *make* a membrane as described by the books, and as shown by the London lens. Turning the collar of the 1-6th so as to throw the glass considerably out of adjustment, and again focussing the object, I was much amused to find that I had the identical membrane, as shown by the imported glass, and also, that as the collar was moved, the membrane could be made thick or thin to suit!

The result of this little episode was simply this—my friend now owns and uses on *histological* work an American made 1-6th of 180° of aperture.

I have related, as briefly as possible, this little incident, and exactly as it occurred. I desire to say, however, that I do not deny the existence of "Nasmyth's membrane," described in the various works on physiology and histology. Nevertheless candor compels me to state that I have in times past made diligent search, and have failed to recognize a structure which is taught, even in our elementary school books, as if it were a commonplace thing!

Months ago it occurred to me that the

membrane referred to might only be found on teeth of the first dentition, and obviously would be found wanting on the tooth of an adult. This idea sent me to the dentist's office; such specimens were procured, but the "Nasmyth" still defeated my search therefor.

Some months ago I was engaged in teaching microscopy in one of our public schools. At that time I had the class in physiology in hand, and it was my especial purpose to show them *actually*, structures which were described and pictured in the text book used. I had not proceeded far before we ran against this "Nasmyth's membrane," and I was compelled to state substantially the experience which I have now related to you.

There is not a class of persons on earth less appreciated or more poorly paid than those engaged in histological investigations, and for their indefatigable perseverance I entertain a profound respect; but it has often occurred to me that as a class they have been content to work with very poor tools, and it is safe to say that a great deal of the ground already studied will have to be reinvestigated, and with better glasses—with a better knowledge of those manipulations requisite to the proper use of wide-angled lenses. Nor can the necessary manipulations be acquired in the ordinary routine of investigation; it is an art of itself, and calls for special attention, requiring as much study as the art of manipulating a piano forte or an organ.

It is a very commonplace remark, that, for the purposes of the histologist, low angled glasses, of moderate definition, are the best suited. And yet, if we consult their latest works, we will find structures described that call for the best lenses of the widest angles. Take, for instance, the muscle sheaths, or the axis cylinders of the nerves described by Frey, in his last edition. Coming down to commonplace things, I affirm that the simple trachea of a bee cannot be studied with advantage with other than lenses of the widest angles.

There is perhaps no microscopic object more common than these tracheas. They are to be found mounted in the cabinet of every microscopist, and we have all of us read about them in the books; we have examined them again and again, times without number, with objectives ranging from the inch to the 1-5th, or perhaps to the 1-10th. Now I ask you to take a look at them on my account, and if possible inform me how these tracheal coils terminate: what is the structure at their *very last end?* what is the least diameter of these terminal coils? Here you have a problem in hand, to which, for exquisite intensity of definition, or nicety of manipulation, the resolution of the Möller or Nobert plates are child's play matters! And if you should be desirous of testing your lenses as to their capacity for histological work, the trachea will be found to be one of the very best test objects in existence, and will surely furnish you valuable ideas as to the relative value of wide and low angled glasses for the purposes of histological research.

Not long since one of our most skilful physicians sent me a sample of urine from a child supposed to be suffering from a disease of the kidneys. It was a perplexing case, and the medical gentleman in charge hoped that the microscope would give some light on the case; when examined with a low power 1-5th of 70° aperture, the specimen appeared in every respect healthy; but on further examination with a wide-angled glass, and with an amplification of nearly 4,000 diameters, it was found to be literally swarming with vibriones. There were billions upon billions of them in every field examined, all of which were totally invisible to the low-angled 1-5th.

We often hear the remark, that wide angled glasses are just the thing for the display of lined objects, surface markings, diatoms, etc., but that owing to their short focal length, and limited working distance—the trouble attending the adjustment of collar—and in general, the difficulties pertaining to their use, that they are unsuited to the purposes of the histologist; while on the contrary, low-angled glasses of greater working distance, requiring no skill in management, are the tools with which the real work of the microscope has been, and will continue to be done, and such are fondly termed good, honest, and reliable "working glasses."

I can never listen to this line of argument without entertaining the suspicion that sloth and inactivity lay at the bottom. We never hear astronomers complain of the care they are compelled to use in instrumentation; on the contrary, they pride themselves on the accomplishment of being able to work instruments requiring a great amount of skill and precision in manipulation.

The objection of short working distance originated years ago, when German pathologists were in the habit of using common window glass to cover their mounts, and at that time the extremely thin glass, now so easily procurable, was unknown. All this is now changed; the widest angled lenses known, giving all desirable amplification, will admit the use of covers 1-50th of an inch thick, while covering glass measuring .003 can easily be procured.

A vast amount of work *has* been done with these "honest and reliable working glasses," and, as I have before said, will have to be done over again, and this revisory work is now in progress. But while there is some excuse for the investigators of the past, who used the best instruments then obtainable, what shall we say of those of to-day who persistently refuse to avail themselves of the wonderful progress the optician is able to demonstrate in this centennial year?

I have advanced the idea that working pathologists were too often content to work with poor tools. I made that remark in good faith, and believe that it will be found to be true. Nevertheless the pathologists of the past, or even of the present day, are by no means wholly at fault, when we remember that the entire corps of observers to whom we are indebted for all that has been taught through the aid of the microscope, were men who were regularly engaged in the respective duties of their several professions, and that most of them have filled professional chairs in various institutions of learning. These men, in studying the use of the microscope, each and every one of them, were compelled to dig and trench for themselves; the instrument which to them was as all-important as the compass to the navigator, was far, very far, from being as true and reliable as "the needle to the pole." Once launched on the unknown, but, to them, fascinating sea of scientific investigation, every spare moment that could be snatched from their regular engagements was devoted to its exploration. It was a tiny sea, within a microcosm, replete with interest, and capable, as if by the touch of the optician's wand, of boundless expansion!

These self-abnegating, self-sacrificing men fully accomplished their task. It was a labor of love, and the results they obtained were given to the world without money and without price.

Among the investigators of our own day, I will refer you to one whose untiring industry has earned for him a world-wide reputation. I allude to Dr. Lionel S. Beale, F. R. S. Dr. Beale, as you are aware, has been cotemporary with, and the supporter of, Dr. Carpenter's heretofore universally received opinions as to the relative capacity of wide and low angled objectives. Dr. Beale, in his work, "How to Work with the Microscope,"—I quote from the third edition, page 7—says as follows: "For ordinary work it will be found inconvenient if the object-glass when in focus comes too close to the object. This is a defect in glasses having a high angle of aperture. * * * Glasses with a high angle of aperture admit much light, and define many structures of an exceedingly delicate nature, which look confused when examined by ordinary powers. For general work I recommend glasses with an angle of not more than 50° to 100°.

"Mr. Ross has lately made glasses having an angle of 170°, which are valuable for investigations upon very delicate and thin structures, such as the diatomaceæ; but such powers are not well adapted for ordinary work. The importance of arranging the object very carefully, and the necessity of paying great attention to the illumination, render these glasses inconvenient for general observation. The penetrating power of glasses with a low angle is much greater than in those of a high angle of aperture, so that exact focussing is much more important in the latter than in the former."

This, in its popular acceptation, is the square doctrine first advanced by Dr. Carpenter, and it has suffered no loss by its filtration through the mind of Dr. Beale. It is the doctrine which has been generally received and accepted. It is the dogma which ten years ago I thought ought not to be true, and of which to-night I stand before you the prince of sceptics!

In the quotation which I have presented, there are two dominant ideas; the one displays the *inconvenience* attending the use of wide-angled glasses, and to this objection I have already paid my respects in due form; the other presents the theory of "penetration" as originally advanced by Dr. Carpenter, supported by Dr. Beale, and generally endorsed by microscopists of Europe and America.

I have not the time this evening, nor would I weary your patience by the discussion of this dogma of penetration, any further than to admit that it was true ten years ago, when first announced by Dr. Carpenter, but can have no possible *present* force in reference to the wide aperture glasses of to-day. I am also quite prepared to grant that a spectacle lens of sixty inches focus needs less skill in management than a duplex 1-10th of plus 180° of aperture!

After all, I get considerable comfort out of the quotation already presented. Dr. Beale says, "that glasses with a high angle of aperture admit much light, and define many structures of an exceedingly delicate nature, which look confused when examined by ordinary powers." Notice the wording; he does not say diatoms. He does say, "many structures of an exceedingly delicate nature, which look confused when examined by ordinary powers." It is a candid and manly admission, and I honor his candor. It is the truth, the whole truth, and nothing but the truth; while for brevity of form, or clearness of expression, these half dozen words leave nothing to be desired beyond what is here so forcibly stated; and I beg of you not to lose sight of the fact that if this was true of wide-angled glasses made in 1865, it is *equally* so of those of 1876.

Another fact will bear to be borne in mind. It is this: when Dr. Beale wrote in 1865 he was very far from being expert in the use of wide apertures. I will read to you further from the same paragraph: "In order to adjust the object-glass, it is first arranged for an uncovered object; then any object covered with thin glass is brought into focus by moving the body of the microscope; next, the ring which carries the third lens is screwed round until any particles of dust upon the upper surface of the glass are brought into focus. The glass is then corrected for examining the covered object which may be brought into focus."

It will be seen that the method of adjustment adopted by Dr. Beale is precisely the same as that used by many for measuring the thickness of covering glass, and when the milled head of the fine adjustment is properly graduated, and the "run" of the fine adjustment is known, the plan is a convenient one, and will give measures tolerably correct; but for the purpose of adjusting an object-glass it is obviously faulty, and would in almost every instance defeat such wide angled lenses as I am in the habit of using. Dr. Beale's instructions as to the adjustment of wide-angled lenses must be taken "cum grano salis," and will indeed be more honored in the breach than in the observance.

It is with pleasure that I now turn to page 217, and read as follows: "Besides extreme minuteness in mere size, extreme tenuity or transparency may interfere with the definition of an object. Now the greatest difference is observed in object-glasses in this particular. The *best* object-glasses will define *clearly* and *accurately*—mark the words, 'clearly and accurately'—bodies which, from their transparency, are quite invisible under objectives only slightly inferior to the first."

Now the question arises at once, Where shall we find these best object-glasses, which define so clearly and so accurately such delicate and transparent objects? Referring again to page 7, Dr. Beale responds thus: "Glasses with a high angle of aperture admit much light, and define many structures of an exceedingly delicate nature, which look confused when examined by ordinary powers."

The Doctor having thus squarely settled the question, most kindly goes on to tell us where we can get these wide-angled glasses, and I read right along, as before quoted: "Mr. Ross has lately made glasses having an angle of 170°, which are valuable for investigations upon very many delicate and thin structures," etc., etc.

It is especially a part of my purpose in appearing before you this evening to show you "clearly and accurately," and by the aid of glasses of American manufacture, which for width of aperture have never been excelled, some of these extremely thin and transparent objects, and thus prove to you the truth of Dr. Beale's assertion; and relying on the correctness of the old adage, that "seeing is believing," I can hardly fail in the demonstration of the accuracy of Dr. Beale's position.

Pardon a momentary digression, and allow me to turn to page 216. Here I read: "If any one makes out new points of structure by any new method, all that such an authority who differs has to do is to state that he has not been able to see the structure described so and so. *Authority* too often denies the existence of what it has itself been unable to see. Many authorities deny the existence of what they have not seen, while they have not taken the pains to try the only method of demonstration by which the appearances in question could be seen."

Now we perceive that the Doctor is in a complaining mood. The root of the matter was simply this: Dr. Beale paid great attention to instrumentation; the first 1-25th and the first 1-50th objectives in existence were made for him; he was not very particular as to their angle, although it is noticeable that he claimed for them "plenty of light." But the fact is indisputable that his instrumentation has been in advance of that of the London microscopists. Dr. Beale was in fact in a position very similar to those of the present day, who, conscious of the superiority of their glasses, are disposed to regard the blind "authorities" referred to as unworthy of special consideration.

I desire in this connection to call your attention to the history of the diatom of which we have all of us heard so much about during the past nine years. I refer to *Amphipleura pellucida*. Who of us here cannot recall the time when the existence of striæ on this shell was stoutly denied? We can remember, too, when Dr. Woodward settled this much vexed question by producing his photographs displaying the striæ on what he was pleased to call "this well-marked diatom." And now that these markings are no longer to be questioned, as exhibited on dry mounts, and by the employment of monochromatic sunlight, full eighty per cent of our American observers fail to exhibit "this well-marked diatom" by lamp illumination, even when dry mounted. I have a balsam mount of this shell with me, and hope to show you the lines of No. 20 of the Möller plate this evening before we part, and also the 19th band of the Nobert test plate, and by the aid of American made lenses of medium power.

To be continued.

—Between San Jose and Santa Clara, Cal., there are large quantities of silk-worms at large. They are understood to be from the old stock of M. Provost. They multiplied on the poplar trees, then attacked the fruit trees, and finally gathered on the warm side of a brick building, spinning thousands of cocoons.

The Amplifier.

ANY lens or combination of lenses magnifying an object, in a microscope or telescope, is an amplifier, but the term is more especially used to designate a concave lens (of which various forms are used, either achromatic or otherwise) when said lens or combination is placed between the objective and the eye-piece of a microscope or telescope.

Of late the credit of applying such lenses to the compound microscope has been claimed by some for Dr. Wythe, the writer of a recent American book on the microscope, whilst others are certain that Mr. R. B. Tolles, of Boston, has made similar amplifiers for many years, some say twenty years ago.

Professor Barlow, in 1829, constructed a large telescope of 5 or 6 inches aperture, with a "simple plate" lens for an objective, and used a fluid (sulphuret of carbon) biconcave lens, by which he accomplished two things: 1st, he achromatized his "simple plate" objective lens and obtained the same amplification with a much reduced length of tube. This is, I believe, the first amplifier used in the telescope. Mr. Rogers, about the same time, constructed a telescope with a single solid crown glass lens, with a smaller solid flint concave, acting in the same manner as the fluid lens of Prof. Barlow. Both Mr. Rogers and Prof. Barlow must have known at the time that Charles Chevalier used a similar amplifier on the microscope.

John Browning, of London, manufactures at present an amplifier for the telescope, formed of an achromatic combination of a negative focus, which he calls a "Barlow's lens," for use between the eye-piece and object-glass, so as to obtain an increase in the power of the eye-piece.

I have as yet only alluded to the amplifier as used on the telescope. I will now give its gradual introduction in the microscope.

About the year 1823, Charles Chevalier, an optician of note, in Paris, France, applied the plano-concave lens (achromatic, I believe) to the uppermost end of the achromatic doublets used on the simple microscope, for the two-fold purpose of amplifying the image, and increasing the distance between the objective and object.

In the year 1825, Charles Chevalier improved the construction of the solar microscope, and added to it an amplifier, consisting of a plano-concave achromatic lens, placed back of the achromatic objective.

M. Arthur Chevalier, his son, continues to make solar microscopes, with the amplifier, (lentille plano-concave achromatique.)

Secretan & Lerebours, of Paris, also made solar microscopes with amplifiers, and I have one made by them in 1857. The amplifier is a biconcave lens, similar to that described as the Wythe amplifier. It is placed on a small adapter, and slides into the short tube of the solar microscope, behind the objectives, and its amplifying power is increased or decreased by changing the distance between the objective and biconcave lens. The amplifier adapted to the solar microscope enables us to obtain either a more magnified image, or the same image on a screen, at one-half the distance required without the combination.

I had myself tried various biconcave achromatic and non-achromatic lenses, such as form the eye-pieces of opera or marine and field glasses, both half-way between the objective and eye-piece, and just above the objective of my compound microscopes, but I always found that, in equal ratio with the amplification obtained, I lost light and definition, and considered the amplifier useless on the compound microscope. Hearing of late so much about the Tolles amplifier, and the magnificent results obtained by it with resolving objectives, I obtained one from Mr. Tolles, through his friend and agent, Mr. Charles Stodder, of Boston, and though purchased with doubts as to its practical use, I must say that I was agreeably disappointed in the result. Used on a large compound microscope, with lenses of various makers of 1-10, 1-16, and 1-20, the

Tolles amplifier caused resolutions on the Nobert 19th band plate, which without it, at the same time, and with the same illumination, could not be seen with the same objectives; with that increased resolution the loss of light was not appreciable. The amplifier, being placed on a draw-tube, which allowed it to be removed at once, and the eye-piece alone substituted; its value could readily be discovered. Another quality of the Tolles amplifier is that its use does not require any change in the adjustment of the object glass; as is the case with a change of eye-piece, or an increase in the length of tube, the change in the focus being hardly perceptible.

The R. B. Tolles amplifier is an achromatic concavo-convex lens with its concave surface upwards, and is not similar to either the biconcave amplifier of Dr. Wythe, or those I had used in my experiments. To the peculiar form or curve of the lens, some of the results may be due, but a great part, if not all, are due to the manipulative skill of Mr. Tolles.

Mr. R. B. Tolles has not invented the amplifier, but his construction of that lens or combination is as much in advance of other amplifiers, as his object-glasses surpass in excellence those of other makers who use similar combinations. To R. B. Tolles belongs, however, the credit of having first applied the amplifier to the compound microscope.

Every microscopist should possess a Tolles' amplifier, or a similar instrument; its cost is but little more than that of an ordinary eye-piece, and as it may be used with every eye-piece, its possession is equal to having twice as many such glasses; and the possessor of a good modern objective of moderate power can accomplish with it almost anything that would require an objective of the same grade and of double magnifying power; thus a 1-12th, with an amplifier, will do the same work that a 1-24th would without the amplifier. Object-glasses of high-power are very expensive, when well made, and require great manipulative skill for their use, while a medium power of the best quality is not half as expensive, is easily worked, and is more frequently needed.

The value of the Tolles' amplifier was also made quite apparent by two photographs, showing the resolution of *Amphipleura pellucida*, one by a 1-25th and the other by a 1-12th objective of Tolles, the latter with his amplifier. The resolution into transverse striæ, in both photographs, and their appearance, is so similar, that were they not numbered I could not tell which was obtained by the 1-25th objective.

In writing the above I have endeavored to give the history of the amplifier, and also its uses, and hope some of the many readers of this journal may correct any error or state any omission in the article.

GUSTAVUS DEVRON, M. D.

New Orleans, Dec. 15, 1877.

Entomological Pins Seized for Duties.

THE following article, which we clip from the *Canadian Entomologist*, can hardly fail to bring a blush to the cheeks of every scientific man in the United States:

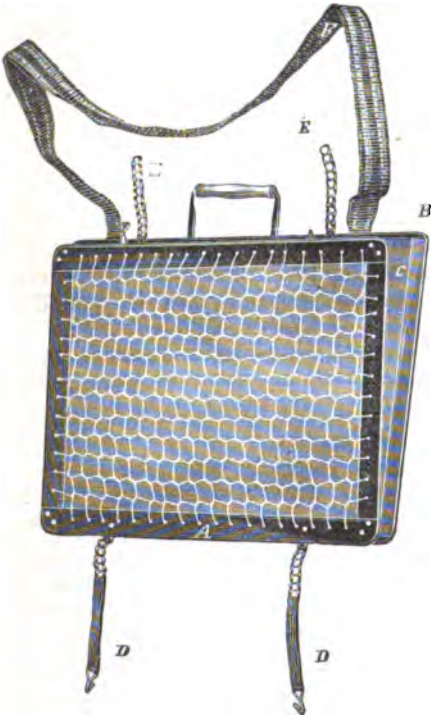
> For some years past our society has kept a small stock of entomological pins, not for the purpose of gain, but for the convenience of our members, many of whom, in the United States, as well as in Canada, have obtained their supplies from us in small packages transmitted through the mail. Recently the custom-house officer at Detroit seized several packages of these pins, and demanded for their release charges amounting to more than their value. This action, it appears, was prompted by a special circular from the Treasury Department at Washington to the collectors, requiring increased vigilance in regard to packages transmitted by mail—to prevent loss of revenue to the Department.
>
> On being informed of the seizures, we wrote to the Secretary of the Treasury, explaining the objects of our society in this matter, referring to past usage, and also to the fact that these pins were only used for scientific purposes. In reply the Secretary holds that entomological pins must take their place alongside of other pins, and pay a duty of 35 per cent, and that the transmission of such packages by mail is

contrary to law. At the same time he kindly instructed the collector at Detroit to waive the usual charges on seized goods, and deliver the pins in his possession on payment of duties only. We shall hence in future be prevented from supplying our members in the United States with pins by parcel post.

Roessler's Portable Wire Plant-Press.

BY PROF. D. C. EATON.

A FEW years ago, Professor Alphonso Wood described in the "Bulletin of the Torrey Botanical Club," a wire or wire-netting botanical press, which he had found of great service while collecting plants in California. But it does not appear that any presses of Prof. Wood's pattern were ever manufactured for sale.



ROESSLER'S PORTABLE WIRE PLANT-PRESS.

Mr. Paul Roessler, of New Haven, Conn., has now, however, perfected a wire botanical press, something like Prof. Wood's, but more like the presses used in some parts of Germany. It will be seen from the accompanying engraving that instead of a heavy wire border, the border is of thin strap iron, A, which is perhaps an improvement.

One side of the press is furnished with four chain-work straps E, and the other side with four little hooks, projections, to which the chains may be fastened, by any one of their links, with no trouble, so that whether empty or full the press will securely hold and compress its contents. Elastic straps, D, at the ends of the chains, are furnished with hooks to secure the chains, so that the press cannot be thrown open by accident, but may be opened and readjusted without delay. The presses have their sides of knitted wire-work drawn tight, and are handsomely japanned, so that they will not rust. They may be carried by either a handle or a strap, as seen in the figure. Presses or portfolios of this kind have the very great advantage of permitting evaporation to go on from the sides, while board presses depend entirely on absorption by the dryers. I have found that by the use of a press of this kind, even kelps and rockweeds (Laminariæ and R. Fuci) may be readily dried, especially if the press be placed in a current of heated air, as, for instance, over a common hot-air register. These presses are made of just the proper size to prepare specimens suitable for the common size of American herbarium paper, 16⅜ by 11½ inches.

College Workshops.

REFERRING to the fact that the liquefaction of oxygen, recently accomplished by MM. Pictet & Cailletet, has been within the reach of English scientific workers for years, *Nature* makes the following pungent remarks: "It is also clear that to cope with modern requirements our laboratories must no longer contain merely an antiquated air-pump, a Leyden jar, and a few bottles, as many of them do. The professor should be in charge of a work-shop, instead of an old curiosity shop, and the scale of his operations must be large if he is to march with the times."

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MR. CHARLES STODDER, 131 Devonshire Street, Boston.
S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 88 State Street, Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Notice to Subscribers.

THE present number of the JOURNAL will be sent to all old subscribers except those who have positively ordered a discontinuance. We hope that those who intend to subscribe for next year will remit as soon as possible. Those who order through our agents are, however, requested to make payment to them.

Deferred.

WANT of space compels us this month to hold over several interesting and important articles, amongst others an important communication from Hon. J. D. Cox in regard to some very successful results obtained at the Army Medical Museum in the use of high angle objectives with the binocular; one from Prof. J. E. Smith; several illustrated articles, and our entire "Book Table." The March number promises to be very rich in interesting and important matter.

To Cut or Not to Cut!

MANY of our readers have expressed a desire that we would not cut the edges of the JOURNAL, the margin now left being rather small when the volumes come to be rebound. To send out some cut and some uncut would involve a great deal of extra labor. Now, as we believe in the good republican rule that the majority should govern, we intend to decide this question by asking all our subscribers to express their wishes on this point. This may be easily done on a postal card.

It would be easy to give more margin by contracting the reading matter, but this we shall not do. We use a fair-sized type, and give very large pages, as may be seen by comparing our journal with others of a similar size of leaf. Our object has always been to give as much as possible in the way of reading matter and illustrations as the price would allow. Some of our readers have told us that they would gladly double, or treble, even, the present rate, and we fully appreciate their kindly feelings, but unfortunately there are too many of our subscribers who *cannot* be thus liberal, and yet who enjoy the journal.

Concerning Sub-Stages.

AMONGST our correspondence the reader will find an important letter from Mr. Zentmayer in regard to the originality of his method of swinging the sub-stage.

Duties on Philosophical Apparatus and Books.

WE see that in the new tariff bill the old rate of 40 per cent is laid on philosophical apparatus, which, of course, includes microscopes; and 25 per cent on books.

The propriety of such a duty we do not propose to discuss. There are intelligent and honest men, both on the side of free trade and on that of protection. So far as books are concerned, however, we feel that the tax is one which favors a few manufacturers at the expense of every student in the land. Our publishers are very ready to reprint popular foreign books, which have a large sale amongst general readers, but which are of little value to real students, and in order to protect them in this piracy, the student of natural history who is obliged to use the "Micrographic Dictionary," or "Beale on the Microscope," has hitherto been required to pay an additional 35 per cent in gold! We would suggest to the framers of the new law that even though our publishers should be encouraged to act as pirates, they should not be permitted to act as dogs in the manger—neither selling books themselves nor allowing others to sell. At least let all foreign books that have not been republished in this country come in duty free; this will include all the expensive books of greatest scientific value, and our students will not be hampered, while our publishers will not be despoiled of their ill-gotten gains.

In regard to philosophical apparatus, however, and especially microscopes, while we do not care at present to discuss the question of protection or no protection, there is one point to which we cannot help calling the attention of our legislators. We refer to that part of the law which enables colleges and chartered institutions to import these things duty free. The idea that a rich corporation, like Columbia College or Cornell University, should be allowed to import a thousand dollar microscope free of all duty, while the poor self-taught student who, by dint of hard economy, has scraped together a few dollars, and at last purchases a twenty dollar French instrument, shall be obliged to pay 40 per cent in gold on it, is a monstrous piece of injustice. The microscope is employed more as a means of scientific research and education than as a toy or ornament, and why we should seek to promote the cultivation of science in colleges, and throw restrictions on its culture by individuals is to us inexplicable.

The present system works a double evil; it works injustice of itself, and it tends to extend and perpetuate the very evil which the friends of protection claim that their system is intended to remove. Every one knows that a philosophical instrument maker is enabled to produce goods cheaply just in proportion to the amount that he manufactures. Give a microscope maker an order for one instrument, and it may cost you a thousand dollars; give an order for five hundred, and it is ten to one that the same microscope can be produced for one hundred dollars.

Now, one of the alleged objects of protection is to encourage the production of cheap goods by increasing the quantity produced, and this has always been the chief popular argument for a heavy tariff. In the case of books and philosophical apparatus, the idea of a tariff for *revenue* is utterly absurd; the amount is too insignificant and the influence against education and culture is too obvious. But in the case of both books and apparatus, our present system deprives our American manufacturers of their very best customers, the colleges and chartered societies. It therefore tends more to discourage home manufacture than if these goods were absolutely free, and it unjustly increases the price of both books and instruments to the private student, thus discouraging scientific culture and research, and retarding our civilization. We hope that in regard to these two articles a radical change will be made in this respect, and that the law will no longer discriminate in favor of the rich and powerful as against the poor and weak. Either make books and apparatus wholly free or wholly protected.

Death of Raspail.

JEAN FRANCOIS VINCENT RASPAIL is dead at the ripe old age of 83. His name is known to every microscopist, from the fact that he was the staunch advocate of the simple microscope, and designed one which has always been a favorite, and which bears his hame. His work on "Organic Chemistry," which contains the results of his microscopical investigations, was translated into English in 1843. He was an ardent politician, and in 1830 he took part in the revolutionary movement, and was wounded during the street fighting in Paris. Although official employment was offered him, he kept aloof from the government of Louis Phillippe, and was so zealous a Republican that he became the object of a series of prosecutions which cost him six years' imprisonment. Meanwhile, he continued his scientific studies, and wrote several works in prison. He took a prominent part in the revolution of 1848, and was a member of the Constitutional Assembly, but having again engaged in committing revolutionary acts, he was sentenced in 1849 to imprisonment for five years. Twice during his stay in prison he was elected a deputy, but, of course, could not act as such. On being liberated in 1851, he went to Belgium, where he resumed his scientific studies. In 1869 he reappeared in public life, and since that time has been better known in politics than in science.

Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Low versus High Power Objectives.

Ed. Am. Jour. Microscopy—In the November number of the JOURNAL, I found, in a letter from Prof. Hitchcock in reply to Prof. J. E. Smith, the following remark: "I would remark that I fail to see the advantage of working a glass up to its fullest capacity with deep eye-pieces. It is trying to any glass, and it is questionable if it is an advantage to use an inch objective to see 30,000 lines to an inch with a deep eye-piece. * * * I dare say few workers will be induced to follow this plan—in fact few 1 inch objectives would stand it at all."

To the last part of this remark I can give my assent, for I fear that (comparatively) few workers will be induced to adopt this plan, for unfortunately a large number of our American microscopists are under the baleful influence of the German school, which seems to value microscopes and objectives in *inverse* ratio to their excellence—and have preferred to buy poor imported lenses, instead of good American lenses, and are consequently provided with a class of lenses among which can be found few (very few *if any*) 1 inch objectives which would stand it at all.

Now I am of the number of workers who have been induced to adopt this plan, and I propose to state my reasons therefor, though I have no hope of convincing Prof. Hitchcock of the correctness of my views.

I believe, then, in using first-class wide-angled lenses, of comparatively low amplifying power, and getting the increase of power by the use of deep eye-pieces rather than using only low eye-pieces, and obtaining gradations of power by the use of low-priced narrow-angled *penetrating* objectives.

1st, Because I get better results.

2d, Because it is a more simple, and therefore more rapid and convenient way to work.

3d, Because it is more economical.

I get better results, because the correctness of my lenses are more perfect—because I secure greater working distance. It is the simplest, most rapid and convenient method, because it is easier to lift out one eye-piece and drop in another, than to unscrew one objective and screw on another, and because by this method all chance of disarranging your object and throwing the part you are examining out of the field, is avoided.

It is the most economical, because eye-pieces are so much cheaper than objectives, and where really first-class wide-angled objectives are used, two (1 inch and 1-6 inch), or possibly three (a 2 or 3 inch being added), are all that are needed by anybody for work.

Let me illustrate by referring to the report of our Dunkirk Microscopical Society, published also in the November number of this journal.

Lieut. Carpenter made an admirable dissection of a frog poisoned with Curare, and exhibited the circulation of the blood in the capillaries of the mesentery. For the exhibition of this interesting object (which is certainly physiological, histological and pathological enough to placate the most rabid anti-diatomaniac that ever worked with a French commercial triplet), I selected my Tolles 1 inch objective of 30° aperture and obtained amplifications of 100, 200 and 400 diameters by simply changing the eye-piece.

Now, even with the 1-4 inch solid eye-piece, giving an amplification of 400 diameters, the view of the object was satisfactory (this 1 inch objective stood it), and I had a clear working distance of about 1-3 (more accurately .317 of an inch), and a field a little more than 3-200 of an inch in diameter. Had I adopted Prof. Hitchcock's plan of using cheap narrow-angled objectives with low eye-pieces, I should have found myself under the following disadvantages:

1st, With the lower power my view would not have been satisfactory to me. I want the best possible definition.

2d, It would have taken me longer to change objectives than it did to change eye-pieces.

3d, In changing the objectives, I would have run the chance of disarranging the object.

4th, Supposing I had used a Student 1-5 objective, I should have had only about .018 of an inch working distance, instead of .317 of an inch, which would have been, in this case, at least, extremely inconvenient, as the object was uncovered, and of course kept moist, and the front lens of an objective with such short working distance would be apt to get dim very quickly.

This is practical work, and the best glasses are the best every time, whether the object be a diatom or a pathological specimen.

Now as to wide and narrow angles. Prof. Hitchcock says the real reason of the superiority of modern lenses is not their wide angles, but their more perfect correction. Undoubtedly more perfect correction is an element, and a very important one in the superiority of the best modern lenses over their predecessors, but the increase of angle of aperture is also an important element. This I know, that of two first class lenses, of the same amplifying power but different angle of aperture, the one with the wider angle performs better under all circumstances than the other, and will bear with ease eye-pieces under which the lens with the narrower angle will fail.

The moral of this is, that it is not only better but cheaper to buy the best wide-angled objectives, and pay a fair price for the skill and labor necessarily expended upon them, than to buy narrow angled or poorly constructed lenses at any price. Geo. E. Blackham.

Dunkirk, Dec. 15, 1877.

The New Method of Swinging the Sub-Stage.

Ed. Am. Jour. Microscopy—In the January number of this journal, I find an article describing a new microscope, and think I owe it to your readers and myself, that some notice should be taken of it. I cannot prevent Mr. Bulloch from *saying* that he invented certain arrangements, if he chooses to do so, nor can I prevent him from copying numerous improvements which I have never patented, as, for instance, *his* new mode of centering the stage by lift and press screws, which I made many years ago, and can plainly be seen on page 12 of my old catalogue; or the arrangement in the nose-piece for preventing the breakage of cover-glasses, as adapted to my Centennial Stand, etc., but I can and will prevent him, or any one else, from *making*, *selling* or *using* such parts as are an infringement of my patented mode of swinging the sub-stage.

Joseph Zentmayer.

Philadelphia, Jan. 23, 1878.

Concerning "Penetration."

Ed. Am. Jour. Microscopy—The following note from "Le Microscope," by Dr. J. Pelletan, page 55, states a fact that is generally unknown, but which ought to be known to every one who works with the microscope:

"From a purely theoretical point of view, an objective with penetration is, in reality, a defective objective."

My experience is that there is not one in a thousand of the users of the instrument—especially the histologists—but have the idea, and their opinions are governed by that idea, that an objective that will show at one sight (or focusing) all the strata or planes in a section of a tissue one fiftieth or one hundredth of an inch thick—or, in other words, one that has great "penetrating power" (better defined by the optician's term "depth of focus"), must be the *best* and most important objective that can be made. Whereas it can be demonstrated that such depth of focus is optically incompatible with the best definition, which is the quality above all others desirable in a lens.

Depth of focus is a quality desirable in certain cases and for some purposes; the objectives for such use should be made expressly for that property, and the purchasers of such ought not to expect them to be capable of the highest histological work of modern microscopy.

There is, of course, a *wide* difference in definition of objectives that possess depth of focus. On the other hand *all* objectives that are without that quality do not have the maximum defining power.

All of which only goes to show the need of a critical examination of all objectives that are claimed to be "first-class," and superior to any heretofore made. CARL REDDOTS.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of Jan. 18, Mr. J. D. Hyatt, President, in the chair.

Messrs. G. W. Schramm and H. Lomb were elected regular members, and E. B. Stuart, of Chicago, was elected an associate.

A short paper was read by the Secretary on the angular aperture of objectives, which merely embraced some views which he desired to place on record. One of the principle points held was that the methods commonly used for measuring aperture were inaccurate, and that the real angular aperture of the lenses which are said to have nearly 180°, is far less than this.

Some valuable donations of slides and material were made, embracing stained leaves, foraminifera, polycystina, a section of precious serpentine, prepared by the President, and specimens of diatomaceous material from the following localities: 1. Franzensbad, Campylodiscus clypeus and Navicula rostrata. 2. Oran, Coscinodiscus. 3. Santa Fiora. 4. Kieselguhr de Soos. 5. Kieselguhr de Franzensbad. 6. Fossil deposit from Lake Maggiore, Switzerland.

The diatoms found in this latter deposit are now living in the lake, and the deposit has only been recently discovered. The following is a list of the diatoms composing it: Amphora ovalis; Cocconema cymbeforme; Cyclotella operculata; Cymbella affinis, helvetica, Ventricosa, Ehrenbergii, cuspidata, maculata; Epithemia turgida, zebra, sorex; Fragilaria capucina; Gomphonema dichotomum, tenellium, intricatum, capitatum; Melosira arenaria, (Varians,) distans; Navicula limosa; Odontidium mutabile; Pinnularia elegans, (pusilla,) viridis, gracilis, radiosa; Synedra ulna, splendens, amphirhynchus, biceps, gracilis.

A paper was announced for the next meeting to be read by the Secretary; subject, "The Use of Salicylic Acid in Microscopy."

Mr. Charles S. Shultz, of Hoboken, was present as a visitor, and brought with him a small bottle containing numerous specimens of Volvox globator, which he had obtained beneath ice four and a quarter inches in thickness.

R. HITCHCOCK, Recording Secretary.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, January 3d, with a fine attendance of members, and President Ashburner in the Chair. Dr. Eisen, Corresponding Member, was present; also Dr. Behr, as a visitor.

Additions to the library were announced, in the way of "Proceedings of the Belgian Microscopical Society," "Owens' Odontography," with volume of plates; "Catalogue of the Diatomaceæ," by Fred. Habirshaw; "American Naturalist," "Grevillea," "Popular Science Monthly," "Nature," "Science Observer," and AMERICAN JOURNAL OF MICROSCOPY.

To the Cabinet the California State Geological Society donated a sample of diatomaceous earth from Port Harford, San Luis Obispo county, Cal. Mr. Hanks presented a slide mounted by him with some samples of native silver ore, coated with chloride of silver, and the same after treatment with ammonia; also, a silver globule obtained by assay from 100 millegrams of the crude mineral. Regarding these specimens, Mr. Hanks said that there was little in their appearance to lead a casual observer to suspect its character, though an examination of the native silver with the microscope at once reveals its true nature, and was a most striking example of the importance of our favorite instrument in the determination of mineral substances. He also mentioned a very interesting fact in the unwritten history of the mine in which the mineral occurs. The Valeria mine, Guijas District, Pima county, Arizona, was re-discovered March 27th, 1877, and the prospectors found an old shaft twenty feet deep, from the bottom of which a level had been driven forty feet. At the opening of the shaft lay three tons or more of rich, but what is erroneously termed rebellious ore. A mesquit tree, a foot in diameter, was rooted in the pile of ore. On cleaning out the drift, a human skeleton was found, with copper and stone tools, and near the remains was discovered a pocket in the vein, from which nine or ten pounds of this exceedingly rich mineral was taken.

From Prof. F. L. Bardeen, Ann Arbor, Mich., was received, through Mr. Kinne, three slides, mounted by him, with transverse sections of blackberry and sumac and striated muscular fibre, showing primitive fibrillæ.

Prof. Dr. Ernest Haeckel, of Jena, Germany, and J. G. Lemmon, of Sierra Valley, California, were elected corresponding members of the Society.

Mr. Woodward exhibited a fine specimen of mounting, performed in Nature's laboratory, in the way of an ant in a piece of amber. This relic of cretaceous life had the good fortune to drop himself into the fluid resin as it escaped from the amber-fir, one of the conifera of that age; and thus embalmed, was preserved in the same manner as objects are now mounted in Canada balsam, and when placed under a two-inch objective, was found to be perfect in detail as well as general form. It was fixed on a slide by Mr. Kinne, and placed in the cabinet for future examination.

[Dr. J. H. Wythe read a very interesting paper on the Light-receiving Organs of the Octopus, which we would like to reproduce, if our space would admit of it. We may perhaps find room for it in a subsequent issue. Dr. Gustaf Eisen also delivered a very interesting illustrated lecture.—Ed. Am. Jour. Mic.]

State Microscopical Society of Illinois.—A regular meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, Dec. 28, 1877, Mr. James Otis in the chair.

The donations reported were, "Transactions of the Belgium Microscopical Society," for June, July and August.

The Secretary called attention to a copy of the "Catalogue of the Diatomaceæ," recently issued by Mr. Fred. Habirshaw, of New York. The book is a most complete one, and of great value to the student in this line of natural history; it gives a complete list of all the literature relating to the diatoms, and in the main body of the book, every diatom thus far published is mentioned, together with its synonym, where practicable, and reference is made to the work where it may be found fully described. The work is a private publication, and the issue confined to but fifty copies. Of these only twenty-three remain in this country. It is to be hoped that the book may be reproduced, and be procurable through the regular channels. The Secretary stated that his copy would at all times be accessible to the members of the society.

The paper for the evening was read by Lester Curtis, M. D., who took for his subject, "The Origin of the Bile Ducts in the Liver." The paper was illustrated by carefully prepared charts and diagrams, and was listened to with great interest. The doctor had also prepared several sections of liver, which he exhibited under the various microscopes and fully explained.

H. F. Atwood, Secretary.

PERSONAL.

[Prof. Piper, of Chicago, feeling aggrieved by the remarks which appeared in the reports of the San Francisco and New York Microscopical Societies, has sent us the following letters, which we publish as a matter of justice to him.

As we must decline to continue this controversy in our columns, it is but justice to Mr. Kinne to make the following statement: A copy of Prof. Piper's article (as criticized by Mr. Kinne) is before us, and in that article the figures are referred to throughout as "drawings." The diatom which Mr. Kinne supposed to be diatoma vulgare, seems to us to be a tabellaria. The frustules of the latter are linked together at the corners, somewhat after the fashion in which the diatoma vulgare usually appears, and this probably gave rise to the mistake on a cursory examination of the figure, as reproduced in ordinary newspaper printing.—Ed. Am. J. M.]

68 Centre Avenue,
Chicago, Dec. 24, 1877.

"There was an old Emperor, whose name was Louis Napoleon,
He looked in some lexicons, and saw the word "Mexicans,
Here's at 'em says old Louis Napoleon."

Ed. Am. Jour. Microscopy—Your correspondent[*] of the San Francisco Microscopical Society, has, in his haste to hit somebody, struck at poor Professor Piper, who is entirely innocent of any attack upon diatoms, or water, or any other kind of drink. He is, indeed, I believe, a worthy lecturer upon the art of school teaching. Nor is this the worst of the San Francisco man's terrible onslaught on imaginary giants. But, to depart from metaphor, there is not one truthful statement in his whole communication in regard to any Professor Piper of them all. In the first place, the intelligent Secretary of the Chicago (*sic*) State Microscopical Society never sent any "drawings," either good or bad, to this doughty diatomic Louis Napoleon. What he did send were impressions of wood cuts printed in a daily paper, and these this learned scientist calls drawings, not knowing the difference between a drawing and a wood cut. In the second place, there are no diatoma vulgare in the lake water, as I am informed by those who have made a study of the subject. In the third place, there was no attempt "to fright the soul" of anybody, through the pictures or descriptions of diatoms of any kind. The writer of these articles, as well as every member of the Microscopical Society, and all other citizens who have the welfare of our city at heart, are endeavoring to do all in their power to prevent the fouling of the lake water, and this was the sole purpose of their being written. The diatoms in the drawings are only given as they chanced to come with the other substances in the field of the microscope when the pictures were made. They form but a very small portion of the picture in either case; but they and the algæ were the only things that could be seen by this flippant writer. And upon these he ventured to pronounce ex cathedra, with as much knowledge of them as he evidently possesses of their innocent neighbors, the diatoms. But, Mr. Editor, I dislike thus to expose the pretensions of any one who is trying in ever so small a way to begin the study of science. I would not have done so, had not his official position given him some weight, and his coarse insinuation with regard to my seeking notoriety fully warranted me in doing so. R. U. PIPER, M. D.

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[*] Prof. Piper errs in designating the official Reports of of this (or any other) Society as *correspondence*. The reports are published by the Society in several journals, and we merely reproduce them.—Ed.

P. S.—Since writing the above, I have consulted B. W. Thomas, Esq., of this city, who is regarded by all as authority upon the Diatomaceæ, and he informs me that they are as fond of foul water as pure, and that there is not a pond in the neighborhood of the city, however dirtied by geese or other animals, in which they are not to be found in abundance. He also informs me that he has obtained them from those stagnant waters which are regarded as the sources of malarial fever, in like abundance. Thus it will be seen that your correspondent, who has seen fit to make such a gentlemanly personal attack upon me, has failed to convey a single true statement or insinuation, even to his readers. From ignorance or intention, which? R. U. PIPER, M. D.

CHICAGO, Jan. 18, 1878.

Ed. Am. Jour. Microscopy—Since the article by Mr. Kinne, in your journal, you have seen fit to admit another of like character. How well such communications become a so-called scientific journal, you, of course, must be the judge. The same coarse insinuation is seen in this article as in the one purporting to come from California. It is, perhaps, traceable to the same source, the self-constituted defender of the swill milk and swill beef manufacturers of our city. It is certainly as scientific in its surmises and conclusions as the statements of that writer. So far from seeking notoriety in the case, as is the gentlemanly insinuation in this, precisely as in the California one, the plain truth of the matter is as follows. The officers of the State Humane Society came to me, requesting that I should aid them, so far as lay in my power, to put down this nefarious business by writing some communications for the public press. This little I was glad to be able to do. The "Times" newspaper, with its usual public spirit, opened its columns, and generously went to the expense of the engravings in aid of the good cause. Thus much for the intention. As it regards the scientific value of my articles, allow me to say, that though written for popular reading, I was careful to guard them in this respect. To this end they were submitted to several leading scientific professors in our medical schools, "of the various persuasions," previous to their publication and also since, and now, as then, with full liberty to refer to them (the professors), they pronounce the statement against their scientific character to be utterly untenable, having its foundation in ignorance or malice. Both of these articles, that of Mr. Kinne and that of the New York report, are alike in spirit and character to what happened to me while presenting the matter *viva voce* before a committee of the Common Council. One of the swill milk men stated on that occasion that he was a microscopist, and that he knew my conclusions were false. Upon questioning him, it was found that he did not know what the words "object-glass" and "eye-piece" meant in connection with the instrument. Certainly your correspondent knows as little of the science of medicine. R. U. PIPER.

Humorous.

"A little nonsense, now and then,
Is relished by the wisest men."

The following, from the *Medical Record*, we republish *verbatim et literatim:* We may add, however, that it did not appear in the *humorous* column:

A New High-Power Lens.

To the Editor of the Medical Record:

SIR—The high importance of any improvement or new form of construction tending to augment the value of the microscope as an instrument for medical investigation, emboldens me to ask for a paragraph or two in your overcrowded journal, by way of bringing to the notice of the profession a new objective invented and arranged by myself. Its merits are, that it introduces the condenser as a part of the objective, and thus converts to practical purposes a hitherto-neglected source of illumination, and that it multiplies the power in diameters by five, and in magnitudes by twenty-five, of any objective to which it may be applied, without in the least diminishing its working distance. A 1-10th inch Bardou objective, once mentioned in the *Record* for remarkable defining and penetrating properties, forms the basis of the new lens. With one of Pike's medical stands, C eye-piece, and a long and slender adapter constructed from the tube of a small continental instrument, the unmodified lens has given me a power of 1,500 diameters. With all its original excellence of definition, and with a sufficient working distance so that thin covers can be used, the same lens, as at present arranged, gives by micrometer measurement the extraordinary power of 7,500 diameters, with the assistance of a 3-8th inch condenser introduced as a part of the sub-stage—a power at which the common monad found in perspiration, saliva, and secretions and excretions, can be studied as to details of structure and classification. The diameter of the field at this power is exactly spanned by three blood-corpuscles arranged in linear series; and yet the field has no central depression or cloud, and each corpuscle lies accurately and exactly defined under the eye. By using this modification, with a good 1-8th inch lens, upon a stand of ordinary construction, the medical investigator may obtain all the results obtained by a 1-40th inch lens, without any of the inconveniences incident to the use of such lenses.

FRANCIS GERRY FAIRFIELD, A. B., Ph. D.,
Prof. Microscopy and Micro-chemistry, New York
College of Veterinary Surgeons.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Sections of manzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Wanted, in exchange for a number of fine slides, the polarizing apparatus for a first-class stand. Address F. F. Stanley, 40 Pearl St., Boston, Mass.

Gomphonema germinatum, a pure gathering of "Challenger" soundings, Globigerina, etc.; also, 8 European earths. Good marine and guano diatoms, unmounted, wanted in exchange. W. M. Paterson, Westfield Terrace, Loftus, England.

Mounted or unmounted crystals of tartaric, oxalic, red prussiate, chloride and bichromate of potash, for other objects of interest. Address H. B. Hargreaves, Garnerville, Rockland County, N. Y.

Slides of black rust on wheat stalk, opaque and transparent; stained fertile frond of Adiantum pedatum, etc., for other mounted objects. Address F. H., Drawer 85, Cherokee, Iowa.

Slides of spores of botrychium, and fossil diatoms from Bow, N. H., for other mounted objects. Lists exchanged. Wm. W. Griffin, Lynn, Mass.

Slides of cuticle of larva of Macrosila Carolina, showing crystals, in exchange for other objects. E. A. Burdick, Pension Office, Washington, D. C.

Palates of mollusca, a great variety, mounted or unmounted, in exchange for mounted slides of interesting objects or good material. C. M. Vorce, 164 Lake street, Cleveland, Ohio.

Slides of Arachnoidiscus Ehrenbergii, *in situ*, on seaweed from Santa Cruz, Cal., and Aulacodiscus Kittoni (transparent), for other mounted objects. C. Mason Kinne, No. 422 California street, San Francisco, Cal.

Mounts of Uric Acid (natural urinary deposits) in exchange for other mounted objects of interest. Address W. J. Weeks, Homœopathic Hospital College, Cleveland, Ohio.

Specimens of the marbles, granites and minerals of Vermont, in exchange for Western minerals, or good fossils; minerals and fossil woods from the far West specially desired. Dr. Hiram A. Cutting, State Geologist, Lunenburgh, Essex county, Vt.

For exchange, transparent injections, equal to finest English slides of Thymus and Thyroid glands, stomach, bladder, kidney, mesentary, intestine and tongue of cat. J. T. Joslin, Newburgh, N. Y.

Wanted, in exchange for diatoms from northern Wisconsin and Michigan, any well-mounted objects; marine diatoms preferred. W. H. Titus, M. D., Shawano, Wis.

Slides of various kinds of fertile fern fronds, Indian corn, deutzia, citra odora and other leaves, decolorized and stained, exchanged for other good microscopic objects. C. Blasdale, M. D., Jericho, Queens County, N. Y.

Polyzoa with "bird's heads," foraminifera, polycystina, holothurian plates, synapta anchors, chirodota wheels and young; spicules of sponges and gorgonia, etc., in exchange for foraminifera, pathological, anatomical and vegetable preparations. F. M. Hamlin, M. D., Auburn, N. Y.

Publisher's Department.

Fire Insurance.—We would call attention to the statement of the Home Insurance Company, which we publish on another page. In these days of financial depression it is gratifying to see that the old "Home" maintains its high position as a thoroughly sound and reliable company. One of the most severe blows that can fall on a business man is to find, in the hour of trial, that the support upon which he relied for help is a broken staff. Those who are insured in the Home need dread no such result.

Rich Fancy Goods.—One of the best known and oldest houses in New York, dealing in what are known as "Fancy Goods"—that is, goods of an ornamental, as well as useful character, is that of Schuyler, Hartley & Graham, 20 John street, New York. Those who visit New York should by all means make a call at this establishment, whether they wish to buy for personal use or for purposes of trade. Their stock is so large and well-selected, and comprises so many objects of rare beauty and novelty withal, that it is a most instructive study for those who delight in art as applied to articles of utility.

The Knickerbocker Life Insurance Company.—The name of this company is significant of its character—conservative and cautious, yet enterprising and wide awake. The recent investigations have rendered people cautious in regard to life insurance, but it must be remembered that the weeding process has been very thorough, and those companies that have sustained the searching examinations to which all such concerns have been recently subjected, may be regarded as beyond suspicion. The Knickerbocker makes a specialty of Savings bank Policies—a subject which it would be well for our readers to investigate. Full information can doubtless be obtained from the company, whose office is at 239 Broadway.

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THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

Vol. III. NEW YORK, MARCH, 1878. No. 3.

Discursory Thoughts Relating to the Use and Abuse of the Microscope.

An address delivered by Prof. J. Edwards Smith, before the Dunkirk Microscopical Society, Tuesday evening, October 31, 1876.

(*Concluded from page* 37.)

LET me call your attention, for a few moments only, to another subject. We often hear the diatomist spoken of in terms, almost, of contempt. They are too often regarded by the histologist as a class of observers who use the microscope as a mere plaything; and the fact that the diatomists are not altogether agreed as to the structure of some of their favorite shells, is often used as an argument to show the folly of studying the diatomaceæ at all!

All this, my friends, is sheer sophistry. The study of the diatomaceæ is as legitimate as that of any other branch of the science of biology, and the labors of the diatomists have not been for naught; it is to them, and to their constant demands on the optician, that we are indebted for the wonderful improvements which have been made in object-glasses; and I am bold enough to tell you that skilful diatomists can tell you as much concerning the structure of a diatom, as can the pathologist—equally skilled—inform you as to the structure of a blood corpuscle!

But to the student, to those who desire to *prepare* themselves for advanced work, the study of the diatomaceæ cannot be neglected. No line of practice has yet been discovered that will teach the student the use and management of his tools, that can at all compete with the superior claims of these minute organisms. It is said that "adversity tries us and shows up our best qualities." These little shells, too, will try the would-be manipulator, and, like the country judge, show up his worst qualities.

It was not my purpose to enter at all into the details concerning the use of objectives; but it will perhaps be well not to let the opportunity pass without alluding to the fact that a wide-angled glass requires totally different management, in some respects, from those of narrow apertures.

Those who have been accustomed to the use of the low angles will, on a slight acquaintance with glasses possessing wide apertures, almost invariably assert that the latter do not give as good results, when worked by central, or centrally disposed light, as they are accustomed to get from the former. A moment or two devoted to the consideration of the situation, will, I think, furnish the key thereto.

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When we use a narrow-angled objective, the oblique or lateral rays are per force excluded. The objective will not receive them, and there can be no possible doubt but that such work is being done with centrally disposed light, such as the observer desires; there is no special manipulation or management necessary to secure this, for the objective will admit centrally disposed rays, and none other.

But in the handling of a wide-angled lens the conditions are essentially changed, and this change of condition involves in turn a change of handling, and of management.

Hence it occurs, that in using a wide-angled glass by central or centrally disposed light, some arrangement must be provided for the purpose of shutting out the lateral rays; these the glass will admit, and in default of the provision referred to, will steal in, cause interference, and defeat both observer and objective. To shut out these lateral pencils would seem eminently the business of the usual diaphragm box.

This provoking little piece of apparatus, this diaphragm box, is supplied with almost every stand in use, and is as faulty in operation as human ingenuity in construction could devise; in general these boxes are furnished with a shutter pierced with openings of various sizes, and placed from one-half to one inch below the object-carrier of the stage. Now, suppose we are using a wide-angled lens, and being desirous of central light only, we atttempt the use of the smallest opening of the shutter. What now is the result?

It is as follows: the pencils of light enter the small aperture, emerge and diverge within, and fill the box with simply light of low intensity. It has now become a washed-out, wire-drawn light, lacking force, and, I may say, velocity; the objective now in turn receives this much-abused illumination, not only the central pencils thereof, but lateral ones also; and the working angle used will be determined by the depth and diameter of the diaphragm box.

A proper diaphragm for general use—not diaphragm box, for the less of the *box* the better—is a plate pierced with a central opening of about the size of a large needle, and so mounted as to approach the lower edge of the mount as closely as possible without suffering actual contact. To construct this little piece of apparatus will not make any very severe demands on your mechanical skill.

Those of my hearers who read the London *Monthly Microscopical Journal* will remember that the capacity to display the markings of *Navicula angulata* by central light, was considered a feat only to be performed by low-angled glasses of superior excellence. Some of you, too, may have read the report of a certain biological committee who met in Philadelphia last year for the purpose of testing the object-glasses of several makers; one of the tests used was the exhibition of the markings of this same dry mounted *Navicula angulata* by central light.

I was simply astounded when I read the report, in public print, of this biological committee, and learned that in their hands that *Angulata* had defeated a wide-angled American 1-10th, and I immediately repeated the experiment, using a similar 1-10th, by the same maker, and worked with a diaphragm plate perforated with an opening, say, 1-200th of an inch in diameter, and placed almost in contact with the under surface of the mount. The result was amusing enough! I instantly had the markings "clearly and accurately" defined; the problem was, indeed, to avoid seeing them! In fact nothing short of sheer intention, or, what is worse, bad manipulation, could have defeated the objective. I then repeated the experiment, using this time a balsam mounted *Angulata*—the No. 11 of the Möller plate—and was almost instantly rewarded, as in the previous instance. I am prepared to again repeat this experiment this evening should you so desire.

Again, the converse of what has been said is also true, namely, in working with a wide-angled objective, and with oblique light, it is important to shut out the central pencils. About a year ago, I devised a simple little instrument, which gave access only to a narrow wedge of oblique light, and thus gave added force to the definition of the objective—and this "oblique diaphragm" was permanently fitted to the stage of my stand.

The most efficient instrument of this nature, however, is "Wenham's reflex illuminator," an ingenious accessory, and so contrived as to shut out all rays less than 41° interior, which, of course, has emergence at 90° into air. The reflex illuminator, which was designed by its inventor to give a dark field, becomes, when used on balsam mounts, with American object-glasses, having balsam angles ranging in the nineties, not a *reflex*, but a *direct* illuminator, and a most efficient aid to the definition of the lens. By it I am enabled to show the transverse striæ of No. 20 of the Möller plate so clearly that any old lady who can read her family Bible could hardly fail of recognizing the striæ on "this well-marked diatom." I have the instrument with me, and shall be happy to show you its work on the Möller plate.*

It was mainly the purpose of these desultory remarks to call your attention to the importance of instrumentation; absolute perfection has not been, and never will be obtained. There never has been, nor will there ever be made, an instrument of precision that does not embody inherently some radical weakness, some dangerous fault. The practical astronomer is not only early taught the nature and use of the various instruments to be found in the observatory, and made acquainted with their several imperfections, both optical and mechanical, but he is compelled to acquaint himself thoroughly with the methods employed to eliminate these imperfections. Having thus perforce of his preliminary study acquired a thorough perception of the Scylla and Charybdis which environ the use of instruments, it becomes in turn a life's study to further remove existing difficulties, or to provide better and more competent means of compensation therefor.

I have no doubt but that it would be interesting and instructive to detail some of the exquisitely precise methods employed by the astronomer to detect and compensate for the unavoidable errors of instrumentation, but time forbids. I will, however, notice the nature of one or two difficulties which may be said to infest the observatory.

We are all familiar with the purpose for which the transit instrument is employed, namely, to observe the transit of celestial bodies across the meridian in which the transit is adjusted. To accomplish this, it is evident that the instrument must be permanently placed in that meridian; but, unfortunately, the block of stone has yet to be found solid enough for the purpose. Hence it is usual to ascertain the direction and amount of error, and thus correct the results obtained by observing with the instrument while out of the plane of the meridian. The altitude and azimuth instrument, too, requires frequent and careful attention. To be assured that its object-glass may swing in a vertical plane, observations are nightly made by observing a distant star directly, and immediately afterwards its image as seen in the mercurial horizon. By this means a truly vertical line millions of miles in length is obtained.

Reflecting instruments constructed on the model of the sextant, are cross-questioned by observations on east and west stars, and errors due to eccentricity thereby avoided.

Not only do these painstaking men study their instruments, but they in like manner study themselves, and their capacity to observe is cross-questioned in the severest manner. It is to them well known that the observations of some first-class observers are constantly affected with a plus sign; while, again, those of other equally good observers are affected in a contrary direction. This individual condition is called "personal equation," and has to be thoroughly known and compensated for; and this you must bear in mind, that the amount of error due to personal equation is always comparatively small, and as a consequence is only recognized in the observations of professional experts, trained to machine-like, impassive regularity.

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*Immediately after the introduction of the "reflex," modifications, by changing the angle of the facet, were made by the London opticians, so as to adapt the instrument to their variously-angled objectives, similar modifications were also made here in this country, by Messrs. Tolles and Spencer. Three years ago the writer consulted a skilled artist with the view of making the "reflex" in three separate mountings, changing the angle of the facet in each. Nevertheless, the idea is Wenham's. The mere matter of changing the angle of the facet would naturally occur to any one using the instrument.—J. E. S., January, 1878.

My initial remarks, in which the "Nasmyth's" membrane of the books was discussed in a somewhat discursory manner, were intended as an example, and to give you an illustration in reference to a radical evil, which has in times past tainted the observations of many who use the microscope—I refer to diffraction lines and diffraction borders. To avoid these spectral, illusory appearances, is a consideration of the very first importance—requiring, too, the employment of the finest object-glasses, and that technical skill in the adjustment thereof, which is only acquired by long practice; and to this end the study of the diatomaceæ will be found in the highest degree advantageous. Moreover, one must devote a good deal of study to this ghostly parasite, which too often infests, and to a greater or less extent defeats the unsuspecting observer. And here again the little diatom will render yeoman's service.

Some months ago, Dr. Woodward, to whom we are all so much indebted, published in the London *Monthly Microscopical Journal*, for the express purpose of displaying these illusory appearances, a lithograph from his photograph of *Frustulia Saxonica*. The objective used by Dr. Woodward was an American 1-18th, and was the same glass with which his inimitable photographs of the 19th Nobert band were accomplished.

I took it for granted that the lithograph of *Frustulia Saxonica* was made with the glass intentionally placed out of adjustment, and for the purpose of creating these particular lines. A copy of the London journal is placed at our service this evening, and I invite your inspection of the plate referred to. The whole shell of the diatom will be seen badly distorted, the striæ badly defined, and the diffraction lines are immense!*

Now, after seeing and learning what can be accomplished with a superior objective, when out of adjustment, it will be instructive, and I shall beg your permission, by the employment of a superb glass, accurately adjusted, to show you a similar, but more difficult *Saxonica*, as illuminated by the most oblique beams my extremely thin stage will admit. Thus handled the resolution of *Frustulia Saxonica* becomes one of the most charming and fascinating objects that can well be imagined. We shall thus

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*I may here remark that only a few hours ago my attention was called to a report of a meeting of the London Microscopical Society, held April 5, 1876, and reported in the May number of the London *Microscopical Journal*.

Alluding to the photographs of Frustulia Saxonica, Mr. John Mayall said, "Every one who is familiar with the Frustulia Saxonica, photographs of which Dr. Woodward sent in illustration of his paper in December, knows it to be one of the most difficult test-objects—a diatom that ranks next to Amphipleura pellucida. That particular form of Frustulia is one that I have rarely seen resolved, except by lenses of the highest excellence. I consider Dr. Woodward's photographs of it as in every way most remarkable, evincing first-rate skill brought to bear on one of the finest known lenses." It is hard to tell which is the most "remarkable," the photographs, or this statement of Mr. Mayall's.

As there seems to be much difference of opinion as to these representations of Frustulia Saxonica, both at home and abroad, a word or two may be admissable. When the lithographs first made their appearance in the London *Monthly Microscopical Journal*, one of our most talented experts wrote me saying that he was surprised that Dr. Woodward should have allowed the publication of prints giving such indifferent ideas of the work of American lenses. I replied, that as I then understood the matter, it was Col. Woodward's intention to show the work of the objective purposely placed out of adjustment, and I so continued to think at the date of the above lecture, a fact obvious to the reader. I also suggested that the lithographs might not fairly represent the photographs; that if it was the case, Col. Woodward would surely make the fact known. His silence, however, authorized the inference that the original photos had not suffered at the hands of the lithographer. I think I can now safely affirm that the general opinion is that *one* of these lithographs was intended by Col. W. to give a correct idea as to the appearance of F. Saxonica when *properly* resolved, *i. e.*, that it might be contrasted with the others then presented. Be all this as it may, I am prepared to assert that *no one* of said lithographs gives any idea of the proper resolution of Frustulia Saxonica.—J. E. S., January, 1878.

see the frustule without sensible distortion, the striæ displayed with such exquisite beauty of definition as must command your admiration, and minus, too, the suspicion of a diffraction line!

The attention of Andrew Ross, while examining Podura scales with glasses of his own manufacture, was called to the thickened edge, the "Nasmyth membrane" so plainly seen with the non-adjustable glass he then employed, and to him are we indebted for the collar adjustment now so common to all first-class objectives.

Now, my friends, *good object-glasses*, like astronomers, have their "personal equation." They alone are the ones to be most affected by collar adjustment; an ordinary glass, furnished with compensating screw, is scarcely superior to an ordinary non-adjustable lens; one may turn the collar through its entire range, without sensible or corresponding change in definition. On the contrary, objectives of the widest apertures, and capable of yielding intense definition, require the strictest attention to their adjustment.*

Nor is this all. It is quite possible to accurately adjust a first-class objective, and, nevertheless, in this very act defeat the maximum performance of a first-class glass! When working with oblique light, the maximum performance of a superior glass will be obtained at maximum aperture; if this maximum aperture obtains, with the systems "closed," as is often the case, it is then manifestly our business to use covers of such thickness as will "correct" the objective *at* "closed," and to work such a glass over thinner covers, requiring the lens to "correct" at, or near "open point," would surely defeat its best performance.

It being possible that we may have time in the course of the evening to practically discuss this point, I have brought here an objective which, in any position of its collar, has plus 180° of aperture; its balsam angles are at "closed," 97½°; at half way between "open" and "closed," 95°; at open point, 85°. It will be an easy matter to demonstrate that this glass is defeated by the thin covers of the Möller plates, over which the glass will "correct" near to "open point," and conversely, of the decided increase of definition obtained (and angle also) when worked through a supplemental cover of sufficient thickness to cause adjustment with the systems at, or near "closed."

I have brought here another, and a totally different objective; this glass has a constant balsam angle of 100° through nearly the whole run of its adjusting screw. Manifestly, when using this glass, there need be less attention paid to the thickness of cover, a fact which is demonstrated in practice.

These two objectives were constructed expressly for me, and were especially intended for conjunct use—they are, in truth, companion glasses; either of them will display the 19th band by oblique use of artificial light, and also the markings of *Angulata* by central lamp illumination. Of the two, the first-named has the greatest working distance, and, for reasons already given, will work at *maximum* performance over covers 1-50th of an inch in thickness, and in the hands of one thoroughly conversant with its functions, it is, perhaps, the most generally useful glass.

I have here still another objective of plus 180° of aperture. This glass was intended to be a compromise, and to serve to a great degree the purposes both of the 1-6th and the 1-10th before mentioned. The glass I now refer to has at "closed" a balsam angle of 97½; at open point, 92. The compromise is thus apparent: this 1-6th was made to my order for the gentleman who fills the executive chair of this society. It asks no favors of M. Nobert, nor of a centrally posed *Angulata*, and when one is

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*In an article contributed by Mr. F. H. Wenham—see London *Microscopical Journal* for March, 1876—I read, to wit: "The adjustment seems to be a stumbling block for those advocating an extra immersion theory. We have now in use thousands of serviceable immersion object-glasses, capable of defining most tests, and which have no adjustment, as they are set for an average thickness of cover. They answer well, because in the *immersion* system the errors of cover aberrations are nearly eliminated, and with a balsam intermedium they would be inappreciable." (!!!)—J. E. S.

confined to a 1-6th alone, a glass of this construction will prove of great value.

These conditions, which have still greater force when we include the work of various opticians, need attention and study, in default of which you may expect diffraction lines and diffraction borders; and, perchance, our old friend, the "Nasmyth," may put in an appearance!

I repeat, that it was the dominant purpose of these desultory remarks to call your attention to the importance of microscope instrumentation, and to the manipulations connected therewith. To the fact that it is a study, a profession in itself, and an accomplishment that must be fully mastered at the outset, before one can investigate with precision, or have claim to the confidence of others. In point of fact, the most expert manipulator will constantly have something to learn—there is no landing place where one can stop and rest. The world progresses, and so should the microscopist—*pari passu.*

I take it for granted that nothing I have said will lead you to suppose that I am opposed to the legitimate use of low-angled objectives; nothing could be further from my purpose. When properly used, for preliminary examinations, they are *convenient* and useful, but for advanced work they should be abandoned, and in favor of more *inconvenient* glasses of wider apertures.

A wide-angled lens, incapable of receiving and utilizing central beams, is a faulty and undesirable objective; it is, in fact, but half a glass. And on the other hand, a low-angled objective, incapable of receiving lateral beams, is, in my opinion, equally undesirable, unless, indeed, when we are prepared to sacrifice force of definition to convenience of handling.

It must be admitted that there are functional and characteristic differences in the performance of the two classes of objectives; for instance, a wide-angled glass of relatively shorter focal length will not see so far around an object as will one of narrow aperture and longer focal distance. This, as well as other considerations which might be mentioned, offer no rebutting testimony to the statement already advanced, that the principal advantage presented by the low angles is their convenience in manipulation.

In conclusion, I have to thank you for your kind attention to the rambling remarks I have had the honor of presenting. During the few short hours that I have been in your city, the earth has not had time to make one rotation: but I have had a plenty of time to experience and enjoy a generous hospitality. I am now ready to show you the promised objects, and shall be happy to see what *you* have to offer. You will find me ready, willing and ardent to be taught, and in microscope matters be assured I am as absorbent as a sponge.

High-Angled Objectives with Wenham's Binocular.

MR. C. F. COX, of this city, has permitted us to print the following extract from a private letter received by him recently from his brother, Hon. J. D. Cox, M. C. Of course the Dr. Woodward referred to is the celebrated Dr. J. J. Woodward, of the Army Medical Museum, Washington:

"A few days since, Dr. Woodward was showing me some of his beautiful and instructive histological specimens with the binocular, upon the Powell & Lealand stand, with the Wenham prism, when I noticed that we were using the very wide-angled quarter-inch immersion objective of the makers I have named, and oculars giving over four hundred diameters in magnification. The field was brilliantly and evenly illuminated; no distinction could be observed in this respect on using alternately the right and left eye alone, nor was there the slightest appearance of shadow on either margin of either field. I was naturally a little surprised at this, for I have, as you know, tried all the devices which I have seen recommended for the use of the binocular with higher power than the two-thirds, or a low-angled half-inch, and while some of them have helped the bad illumination, none have been a cure. The ground glass in the diaphragm was good as far as it went, but entailed the usual penalty, of unsatisfactory definition, which follows the use of too diffused light. The narrow horizontal slit in the diaphragm, which Dr. Ward recommended years ago, was also of some use, and I have generally worked with it of late, though it only diminishes the difficulty. The shortening of the mounting of the objective, so as to bring the lenses nearer the prism, as Wenham recommended, was another palliative, but still only a palliative. Then there was the dictum of the theorists, which Dr. Carpenter's great authority has made all but universally current, that no lens of over 40° air angle could be used with the binocular without destructive exaggeration of the stereoscopic effect. But here was a lens of the very widest angle, call that angle what you will—a lens with which I saw Dr. Woodward beautifully resolve *Amphipleura pellucida* by sunlight—and we focussed up and down among the cell nucleii of the cornea of a frog's eye, each as perfectly stereoscopic in projection and proportion as could be desired, but without distortion or fault of any kind that could be detected. It was certainly as perfect work of the sort as I ever saw with a two-thirds, judging by any test I could apply; and the doctor unhesitatingly said he thought so too. But how was it done? No special apparatus was used, the light was thrown through the achromatic condenser centrally, with no stop or diaphragm. He worked, in short, just as he would have done with the monocular by central light, and with the same appliances. I, of course, was full of questions. Dr. Woodward said he had his opinion about it, but preferred not to express it categorically till he tested his theory in my presence—demonstrating rather than explaining.

"Leisure hours are not very abundant for either of us, but we found time shortly after for another sitting at the little revolving table. There were several points to which inquiry was addressed, viz., was the difference to be attributed to the mounting of the prism, to the objective, or to the illumination. The doctor took these up successively and in order. We took a Crouch binocular as a good specimen of the stand commonly in use, and found that with its ordinary accessories and objectives, the imperfect and unsatisfactory illumination of the field could not be gotten rid of, when using a higher power than a half-inch. We next tried the Powell & Lealand quarter-inch on the Crouch stand, and found the same trouble with it. The difference in result, therefore, was not due to the difference in the objectives. Then the condenser was removed from the Powell & Lealand stand, and the light taken from the mirror alone. The dark zones at the sides of the two fields immediately appeared as on the Crouch stand. This proved that neither objective nor prism caused the difference of result, and consequently that the illumination by the condenser was the only remaining thing to which the effect could be attributed. Next the doctor changed the condenser, substituting in its place objectives of various powers and angles of aperture. The work was unsatisfactory with all, but approximated most nearly to what we first witnessed, when a high-angled Tolles' fifth was used as condenser. Thus, by a series of systematic steps, each of which had its own interest, it was demonstrated that the very high-angled condenser made by Powell & Lealand was the only one within reach which would give the kind of illumination necessary to secure a perfectly clear field with the quarter-inch immersion; and, further, that not even an equally wide-angled objective could be made to take the place of the condenser, because the latter was evidently corrected, in the making, for the thick glass of the slide through which it must work, while the objective is only corrected for a thick cover glass. Incidentally, in this way, it was proven that a condenser, to do its work thoroughly, must be made for the purpose.

"Upon trying the binocular with higher powers than the quarter, we found that the shadow at sides of field began to appear (though very slight) with the fifth, and with the eighth they were so much larger as to interfere with good illumination about as much as in the case of the quarter inch used with the common Webster condenser.

"We tried the quarter upon one of Walmsley's double stained vegetable preparations, and nothing could be more satisfactory. We worked up and down from top to bottom of the cells, finding no difference in the stereoscopic relation of the parts, from that seen with the two-thirds of low angle. What, then, shall we say of the notion that high-angled glasses cannot be used with the Wenham binocular?"

The Birth of a Tree-Hopper.

BY REV. J. L. ZABRISKIE.

OPPOSITE New Baltimore, in the centre of the Hudson River, lies Haight's Island. It is a strip of low, rich alluvium, partly overflowed by the Spring freshets, nearly a mile and a half in length, about one-fourth of its surface being tilled, or kept in meadow, while the remainder is clothed with timber of large growth, comprising oak, hickory, elm, maple and poplar. The island is intersected by several creeks of considerable length, some of which have a peculiarly romantic beauty, especially in the early Summer, when the thick timber, in full fresh leaf, overarches their gently flowing water, and encloses long curves of leafy tunnel, decked at the sides with conspicuous flowers.

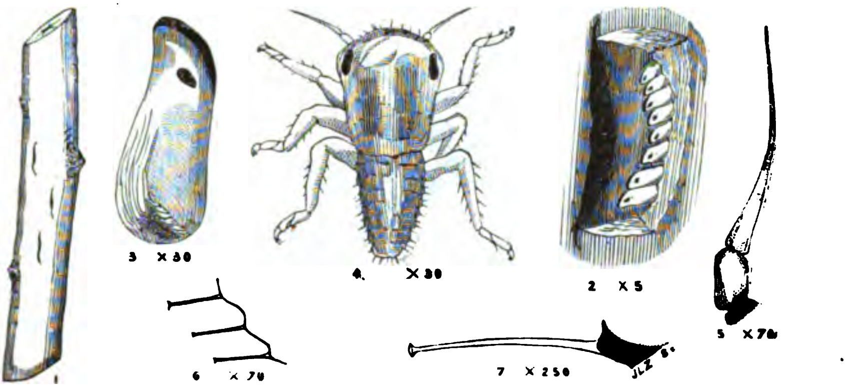
There is here a rich field for the entomologist and the botanist, which is remarkably preserved in its native wildness from the intrusions of the naturalist, and the depredations of the irrepressible small boy, by the simple fact that the only communication from the main shore, in Summer, is by means of the rowboat. Flowering plants and herbs abound in astonishing variety, a natural result of the sowing, by the river, which bears on its current the seeds from all the upper country. And a striking feature in this respect is the remarkable number of species of willows, which fringe the river shores and the banks of the creeks, and which swarm with bees and other pollen-loving insects in the Spring. But the mycologist is especially interested in the fact that this island is a fruitful nursery for the fungi. The deep, moist soil, aided by the humidity of the river air, is peculiarly favorable to a continued succession of multitudes of species of fungi, which revel on the surface of the ground, or are abundantly parasitic on branch, twig, stem and leaf of the rank vegetation.

On a certain afternoon in the latter part of April, while leisurely rowing a small boat up one of the creeks above mentioned, I noticed that the crowded shrub-like stems of the heart-leaved willow (*Salix cordata*), in innumerable instances, had the bark wounded and ruptured; sometimes more than one hundred of these wounds appeared on one stem, from near the surface of the ground up to the twigs of the last year's growth. Down below in the old bark, the wounds had healed, leaving a roughened scar, of about half an inch diameter. Higher up on the tender twigs there were seen little gashes parallel with the axis of the wood, causing a slightly gaping wound, filled with a black, shining substance, and accompanied with a slight swelling of the bark on one side of the gash. Fig. 1 represents three of these gashes on a small portion of a willow twig of the natural size. None of these effects were observed on the wood of the last season's growth; and the black substance, which gave a somewhat fresh appearance to the wounds, was observed in those alone which were found on the wood which was two years old. This fact strengthened the first impression that it was some parasitic fungus, just bursting through the willow bark. But the first application of the knife showed that it was the work of an insect.

Each gash had been made, not perpendicularly to the surface of the bark, and towards the centre of the wood, but obliquely, at a sharp angle with the surface, towards the swelling, which has been noticed above.

A slight act of dissection soon showed that the cause of this swelling was the presence of a nest of insect eggs.

Fig. 2 represents the nest laid open and enlarged five diameters. Two cuts were made, beginning respectively near the upper and lower ends of the black gash, perpendicularly to its general course, and down into the substance of the bark towards the nest. These cuts made a small, but thick flap of bark, which could be opened outwards, like a door swinging on its hinges. The figure represents the nest with this flap of bark, so loosened, entirely removed. This discloses a row of eight white eggs; strikingly resembling a row of little fish, each one placed upon its side, firmly embedded in a little cavity made in the inner bark, and with a prominent eye, and a black line down the centre of the face. One of these eggs, removed from the nest shortly before the time of hatching, and enlarged thirty diameters, is shown at Fig. 3. The large eye, and the black line over the upper end, are prominent features, while parts of the abdomen and the legs, snugly packed together, are plainly seen through their coverings.



THE BIRTH OF A TREE-HOPPER.

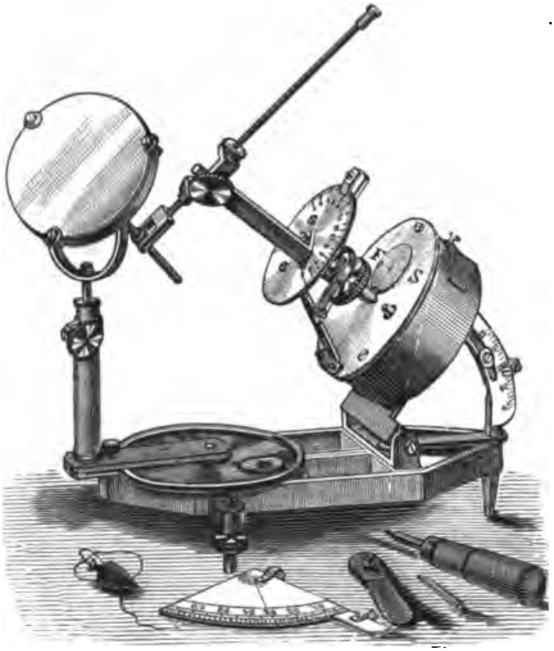
Fig. 1. A willow twig with the gashes. 2. The nest cut open, exposing the eggs. 3. An egg nearly mature. 4. The tree-hopper just hatched. 5. An antenna. 6. Hairs from the side of the abdomen. 7. One of the same more highly magnified.

Some of the willow twigs were cut on the fifth of May, and kept in a jar, with their lower ends standing in water. In two days time little insects were observed, creeping towards the upper extremities of the twigs, and then some of these twigs were examined closely to discover the actions of the little creatures. Patient watching soon disclosed little white footless worms, with two large black eyes, but an entirely white face, breaking through the egg at the black line on its upper end, and working their way outwards through the black gash in the bark. Sometimes these worms would escape entirely from their dark prison, and crawl about on the surface of the outer bark, appearing to adhere to it by some viscid substance on their bodies. At other times, while only half projecting from the gash, the head of the worm would split open, and, after many contortions and struggles, there would gradually emerge the creature represented at Fig. 4, evidently some species of tree-hopper. The birth of one of these was closely watched. In the space of ten minutes it passed through all these struggles, and changed, from the rupturing of the egg until it was free, walking off immediately at a very nimble pace, as if in search of food, and occasionally exhibiting the comical side-long movements characteristic of its kind. Fig. 5 shows one of the antennæ, remarkable for having its upper portion composed of an immense number of minute rings. The segments of the abdomen, also, were studded with very singular hairs, which are shown by Fig. 6 and Fig. 7. The extremity of the hair appears, for some unaccountable purpose, to be expanded into a bell or trumpet shape.

January, 1878.

Keith's Heliostat.

IT is not many years since micro-photography was practiced only by a few microscopists. To-day, owing to improved methods and simplified apparatus, it is employed by comparatively large numbers as a substitute for drawing, which requires special genius and long training. The necessary materials and apparatus for the practice of photography are by no means expensive, and the art is very easily acquired. To those who practice micro-photography by daylight, the heliostat is a great convenience, if not a necessity. Hitherto microscopists have been driven either to rude contrivances, or the very expensive apparatus of Foucault and others. Prof. Keith has therefore done good service to the cause of science, by devising the comparatively cheap and simple apparatus which is illustrated in our cut. The price is moderate—$50,—and the results that may be obtained are very satisfactory. Whenever the sun is shining, it enables the microscopist who has a window with the proper exposure, to bring, in a few minutes, a sunbeam upon the object in his microscope, and keep it there for several hours of study or amusement. At present only one size is made, of which the mirror is three inches in diameter. The whole instrument covers a space of 6 by 10 inches, and weighs about four pounds. It is packed in a neat box. The placing of the instrument in position is very easy, requiring but one or two minutes. It is manufactured by Mr. Edward Kübel, of 326 First street, Washington, D. C.

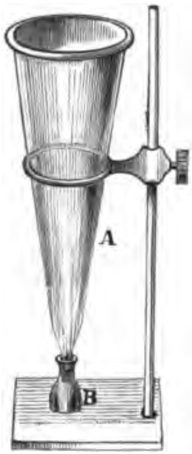


KEITH'S HELIOSTAT.

A Trap for Catching Diatoms and Animalcules.

HAVING had occasion to make a microscopic examination of some potable, well and river water, which are clear as crystal, free from odor, and sweet to the taste, when first collected, it was necessary to provide some means for collecting, from the bulk of water, the objects, if present, that are invisible to the naked eye, so as to be able to place them under the object-glass of the instrument.

The device hit upon gave such entire satisfaction that I take the liberty of sending this account of it to the Journal of Microscopy, in hopes that it may be thought worthy of publication, and prove of interest to other investigators.



The character of the apparatus and its working may readily be devined by a glance at the figure which accompanies this paper. A is a tall, slim glass funnel, with a short neck, that will hold a pint or more. It is attached to a small, wide-mouthed, homœopathic phial or small test-tube B, by means of a stopper made of a piece of india-rubber tube, slipped over the neck of the funnel. I used an ordinary druggist's perculator that holds 32 fluid ounces of water. Fill both, phial and funnel, with the water to be examined, cover with a plate of glass, and let stand for twenty-four hours or more. The apparatus may be supported in an upright position, on the ring of a filter-stand, or on a glass jar with a mouth of sufficient size to catch the body of the funnel.

After standing the requisite length of time, separate the funnel from the phial by a rather quick pull, and let the exhausted water run away. All the suspénded matter, living or dead, which the water contained will be found in the phial. The funnel may now be again attached to the phial and refilled with fresh water, and let stand as before; but it is better, I think, to examine the catch from each funnel full of water separately. The contents of the phial, after it has stood until perfectly settled, may be, if deemed necessary, further concentrated by removing a portion of water with a small syphon.

E. T. Cox.

Indianapolis, Ind.

Finishing Slides.

THERE can be no doubt that a cabinet of nicely-finished slides presents a far more attractive appearance than one in which no attempt at neatness or uniformity has been made. There are many very scientific gentlemen who prefer their slides with unground edges, and plentifully smeared with balsam; it is not for them that this is written, but rather for those who try to make up by neatness and cleanliness what they lack in science.

I stated in a short article in the January number of the Journal that I would soon give directions by which any one could, at slight expense, prepare durable varishes of any color. The colors I use are those put up in collapsible tubes by Winsor & Newton, of London, and sold at ten cents a tube by dealers in artist's materials. A very little of the paint need be used at once—take an amount equal in bulk to a pea, and with it mix an equal amount of dammar; a slight excess of the latter will be better yet, and with the less delicate shades a trifle of gold size may be added. Mix these thoroughly on a glass slide or in an individual butter plate, and it is ready for use.

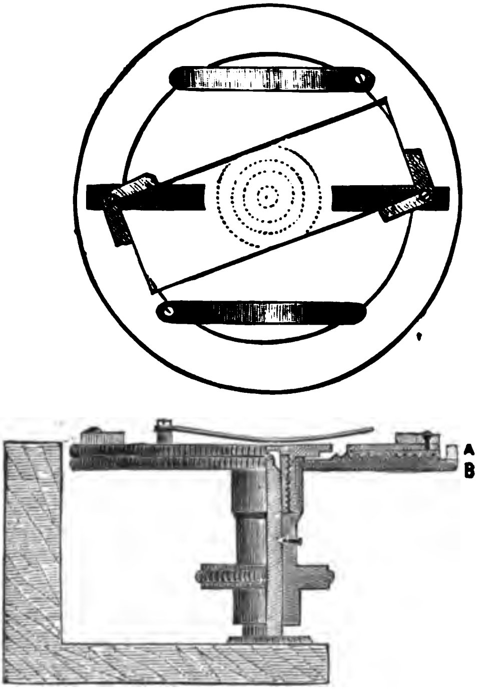
To apply this varnish, as, in fact, any varnish, the brush should be moistened with turpentine every time it is charged. The most desirable colors to buy are, perhaps, crimson, blue and yellow, the two latter being mixed, giving any shade of green by varying the proportions. These colors I use only as a finish, using generally the white zinc cement to fill up with, and then varnishing over it. H. F. Atwood.

Chicago, Jan. 20, 1878.

The Combination Whirling Table.

A Paper read by Prof. R. Hitchcock before the New York Microscopical Society, Feb. 15, 1878.

It may seem to many that a turn-table is a very small and unimportant piece of apparatus, and that the common form is good enough for all practical purposes. For myself, I cannot agree with this view. If one desires to have a good series of mounts, there is, in my opinion, no one instrument which will give so much satisfaction in use, and save so much time, as a good self-centering turn-table. It is therefore without the least hesitation that I call your attention to the one before you, made by Mr. Bulloch, of Chicago. With the other forms, the best of which is doubtless the one invented by Mr. Cox, you are already familiar. The accompanying cuts will serve to give a good idea of its construction.



THE COMBINATION WHIRLING TABLE.

This is a self-centering table, when the jaws are used, but any slide may be centered by placing it under the springs, in the same manner as on the common turn-table.

It will be seen, by referring to the lower figure, which is a sectional view, that the top consists of two plates. The upper plate, A, in which the jaws move, can be turned upon the plate, B. The upper face of B has a scroll screw, such as is found in the American scroll chuck. The lower faces of the jaws have parts of a scroll screw, which work in the scroll of the lower plate. It is readily seen that when the upper plate is caused to turn upon the lower, the jaws will be made to approach each other or separate, as the case may be.

Ordinarily the brush is held in the right hand, and the direction of the motion given to the table is from right to left. There is never any danger of the slide getting loose when turned in this direction, but for a left-handed person they can be made to clamp in the opposite way if desired. The centre upon which it turns is close up under the face plate. This table is perfectly balanced, and consequently the motion is perfectly smooth and regular.

Speaking from practical use, I can say that this instrument has pleased me very much, and I can conceive of nothing better for the purpose. One of the greatest advantages I will show you this evening, and it is simply this. In clamping or releasing the slide, the under plate is moved by the finger of the left hand, which is always in the proper position for doing this when at work. I am not usually an enthusiast about apparatus of this kind, but this improvement deserves the highest praise, particularly when price is considered.

The maker claims it will run two minutes. I have timed it 9½ minutes, and am certain that it can be made to run over ten minutes.

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A New Mailing Box for Slides.

A NEW style of mailing box, contrived by Dr. R. H. Ward, the able editor of the Microscopical department of the *American Naturalist*, has been adopted by the Postal Club, and has proved successful beyond anything tried before. An account of it has been published in the *American Naturalist*, and we reproduce it in the hope that it may be made more generally useful:

"In the boxes hitherto used for posting slides, the slides are occasionally found shattered to pieces, while the box containing them is quite uninjured, or only a little strained. In some boxes containing six or twelve slides, half or more of the slides have been found broken in a perfectly sound box. this seemed to indicate, not the effect of a crushing blow, but the result of the inertia of the slide itself, which was only supported by the wooden racks at the ends, and more or less perfectly by the cotton stuffed around it. An adequate occasion for such an accident might be furnished by throwing the mail-bag from a wagon to the pavement, or transferring it to or from a rapidly-moving train. It was therefore decided to reject the wooden rack altogether, and instead to support the slide by the whole of its edges and much of its sides by cloth, leather, india-rubber, or other soft and evenly-yielding material. This may be attained with the common boxes by removing the racks, lining the top, bottom and end with thick, soft cloth, and arranging folds of the cloth, glued or stitched in place, like a rack at each end of the box, so that a double thickness of the cloth shall extend between the slides from each end one inch towards the centre. It is better, however, to have the boxes made for this use somewhat larger than the customary size, so that very thick beaver cloth can be used for the packing. For six slides, a box may be made of hard wood 3-16ths of an inch thick, 3¾ inches long, 1½ wide, and 1¼ deep, inside measurement. The folds of cloth should be so arranged that not more than an inch in the centre of the slide is unsupported, except when large cover-glasses are to be used, when more space should be left to avoid pressing on the cover. The outside of the box is covered with strong thin cloth.

"The comparative safety of this method is indicated by the experience of the Postal Club. During a trial of several months in many of the circuits, not one slide is known to have been broken while packed in this manner, while to slides in the ordinary boxes with wooden racks accidents are unfortunately frequent. For sending by express, these boxes should be made of thicker wood, or enclosed in larger cases, to prevent crushing by the weight of heavy packages among which they may be carried."

Will it Show the Animalcules in Water?

THE first question always asked when a beginner is about to buy a microscope is, "How much does it magnify?" The second as invariably is, "Will it show the animalcules in water?" Let us try to answer the latter question in such a way that the young microscopist may have a clear idea of what he ought to expect.

Pure water contains nothing that can be seen with any microscope ever made, up to the present time; no solid particles, no animalcules, no minute vegetables, no spores or germs. *Good* water, such as is ordinarily procured from wells, and such as has been obtained by carefully filtering rain or river water, contains nothing that is visible to any of the microscopes ordinarily used by our ablest scientific men. Over and over again people have brought their instruments to us with the complaint, "My microscope is out of order, for I have carefully examined a drop of water with it, and I can find nothing!" The microscope was all right, but the owner did not know what he ought to expect.

How, then, are we to account for those wonderful pictures of "a drop of water," which we find in almost every popular book on science? Are the animalcules which are shown in them mere creatures of the imagination, which have no real existence?

The creatures ordinarily pictured as "the inhabitants of a drop of water" are in almost all cases the inhabitants of stagnant pools, and to see very many of them requires no microscope at all. More than this, however; where a so-called *drop* is shown, the book-maker almost always manages to give what would be the full complement of inhabitants for some hundreds of drops, not with the intention of deceiving, but for the purpose of making his book or picture more interesting.

That these statements in regard to the popular pictures and descriptions of a drop of water are correct, is easily proved. We have before us at the present moment half a dozen books in which such pictures are found. Selecting one of the most popular and interesting—Miss Catlow's "Drops of Water"—we find four beautiful engravings, each showing an imaginary drop of water and its inhabitants. But these inhabitants can in general only be found after the most diligent search, and in special localities. We might search the water from a dozen ordinary wells before we succeeded in finding any of them. Many of them can only be found in clear, though stagnant pools, while others must be looked for in water which contains decaying animal and vegetable matter. And of all the objects shown in the four "Drops," there is not one that cannot be clearly seen with a microscope magnifying one hundred diameters. Even a good hand magnifier, such as those now commonly sold in hard rubber, and consisting of three lenses, will show their outlines and forms, so that they can be recognized. It is these objects which are usually known as "animalcules," and in general it is much larger creatures (water fleas and the larvæ of insects, for example) that are exhibited by sidewalk showmen under this name. A favorite subject with such exhibitors are the eels in paste or vinegar. Both these objects, as well as the water-fleas, and even the *Volvox Globator*, or beautiful "globe animalcule," as it is popularly called, may be seen by the naked eye, *if properly illuminated.*

We must remember that these minute forms of life differ as widely in size as do the larger animals with which we are more familiar. The whale and the minnow do not differ more in size than do some of the living creatures which are the subjects of study under the microscope, and the largest of which are barely visible to the naked eye. To see the very smallest animalcules, the very beginnings of life, if we may so speak, will severely tax the power of the very best microscopes. But, on the other hand, any good magnifier—such as may be had for a couple of dollars—will enable us to see hundreds of the most interesting animalcules shown in the books.—*Young Scientist.*

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

TERMS—$1.00 per year.

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Important Notice.

We can no longer supply complete sets of Volume I in sheets, but offer all the numbers except Nos. 1, 4 and 8 for 25 cents, by mail, postpaid. We have on hand a few complete copies of Volume I, handsomely bound in cloth, with gilt title, price $1.25. Volume II, in numbers, is also exhausted, but we can supply fresh clean copies, with large margin, bound uniformly with Volume I, for $1.25.

As we desire to place a COMPLETE set of the Journal at the disposal of our subscribers at a moderate rate, We offer Vols. I and II, bound, and Vol. III in numbers as issued, for $2 50 *net*. Those who wish to have their numbers of either Vol. I or Vol. II bound can do so for 35 cents. Postage 10 cents additional.

FOREIGN SUBSCRIBERS.—Subscribers in Great Britain and the Continent of Europe will be supplied at the rate of $1 20, or 5 shillings sterling per year, postage paid. Five copies will be sent for £1. British postage stamps received for single subscriptions. Volumes I and II, bound, will be sent for 5 shillings each, postpaid.

The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

MR. CHARLES STODDER, 131 Devonshire Street, Boston.
S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 88 State Street, Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Notice to Subscribers.

THE present number of the JOURNAL will be sent to all old subscribers except those who have positively ordered a discontinuance. We hope that those who intend to subscribe for next year will remit as soon as possible. Those who order through our agents are, however, requested to make payment to them.

January Numbers Wanted.

WE regret to say that our entire issue of the January number is exhausted. The edition was a large one, and to some several duplicate copies were sent. If any of our friends who have spare copies can send us those that they do not need, they will confer a great favor, as they will enable us to complete files for several new subscribers.

Subscribers for 1878 will be supplied with complete files as early as possible. All will be supplied before the end of the year.

A New Postal Law for the Discouragement of Science.

THERE is an old proverb, which says, "*Ne sutor ultra crepidam,*"—"Let not the shoemaker go beyond his last." Why the poor shoemaker should have been selected as the proper recipient for this advice, it has always exceeded our conundrum-solving powers to find out. Our experience has been that others are more apt to transgress this sound command than are shoemakers and kindred craftsmen.

For example: Here come seven wise men from Boston—publishers all—and they have taken it into their heads that they are the only class of citizens in the United States whose welfare should be consulted in the preparation of a postal law! In this they remind us of the goose in the well-known lines of Pope:

> "While man exclaims, 'See all things for my use!'
> 'See man for mine,' exclaims the pampered goose."

To the proposed law relating to the transmission of periodicals through the mails, no objections can be made. We ourselves have, in the columns of the *Technologist*, urged the adoption of every one of them, and they are good, even if they are not original with their present advocates. In this respect the proposed law is eminently just, simple and uniform in its provisions.

But why should seeds, specimens for scientific study, or samples of goods, be charged more than *Missionary Heralds, At-*

lantic Monthlies, or *Golden Rules?* Do not flowers exert as elevating an influence as Boston transcendentalism? Do not scientific exchanges and specimens promote the diffusion of knowledge quite as much as *Journals of Education?* And yet these Boston law-givers, in their egotism and selfishness, would absolutely exclude from the mails some of the most important means of diffusing sound scientific knowledge!

That nothing which can possibly injure mail matter or post office employees should be allowed to pass through the mails, is too obvious to require more than mere statement, and consequently glass vessels, liquids, pastes, sugar, explosives, etc., ought to be unmailable. But why a microscopic object-glass, securely boxed in its brass case, or the small slips of glass used for microscopic objects, should be so prohibited, we cannot see. In England, from whose laws this section is very closely copied, these things pass freely, and out of thousands of packages thus sent, none has ever caused any injury. But in this country, under our present laws which are not so strictly worded as the proposed law, the post office authorities at Washington have decided that the smallest fragment of glass, "even if enclosed in a cast-iron box and firmly screwed up, is unmailable."* According to this, even a finger-ring, having in it a tiny lock of hair, covered with a minute glass plate, is unmailable, lest it should injure the mails!!

It is true that hundreds of postmasters throughout the country cannot be convinced that such an interpretation of the law is not an absurdity, and they constantly admit glass slides and objectives to the mails. The Boston postmaster, who was consulted in regard to the new law, admits glass slides to his mails, but when they reach New York, our authorities charge them up at double letter rates!

If the proposed law should pass and be enforced, all scientific exchanges between students of microscopy will be stopped, and the seven publishers, through whose influence such disgraceful regulations have been enforced, will have their names crystallized in our scientific literature in no very enviable connection.

The list of substances excluded is indefinite, and consequently far too sweeping. "Poisons" include almost all our minerals, and very many of our finest flower seeds; "metallic substances" include a vast number of harmless and important articles. Under this law a lady could not procure by mail a sample of buttons, if they were made of metal or had metallic eyes! It may perhaps be objected that the authorities would probably rule that such articles are mailable, but the rulings previously quoted forbid this hope. Articles having "angles" are also excluded. Indeed it would be hard to find anything that would be mailable, except the products of these publisher's shops.

The fact is, that this whole section requires careful revision at the hands of business men of sound common sense. The authors of this bill tell us that it has been prepared "after consultation with publishers in different parts of the country." But other people besides publishers use the mails and contribute to the support of the government, and we regard it as a singularly unfortunate thing that the publishers of two religious journals, and one of them a regularly ordained clergyman, should have appended their names to such a thoroughly selfish document as the one before us. A proper liberality to other interests cannot possibly injure the publishers, and is but simple justice to the people at large.

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Cutting the Journal.

IN our last issue we put to the vote of our subscribers the question, "To cut or not to cut." The reply came overwhelmingly, "Cut." Fortunately, however, just at the last moment, comes a new invention, which relieves us entirely from our dilemma. Our binder, Mr. Daniels, has perfected a new machine, by which the leaves are cut apart, and left in nearly the condition that a paper cutter leaves them. They are not trimmed at all, so that the margins remain full size. Feeling assured that the new invention meets the wants of both parties, we dismiss the question.

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*These are the exact words reported to us as the decision of the legal advisers of the Post Office Department. The best men in the country have argued and protested in vain against such rulings. But in the words of Schiller, "Mit der Dummheit kämpfen Götter selbst vergebens."

Our Book Table.

The Magazine of American History, with Notes and Queries. Edited by John Austin Stevens, Librarian of the New York Historical Society. December, 1877, and January, 1878. New York: A. S. Barnes & Co.

The first impression made by this magazine cannot but be favorable, for it is probably not excelled by any journal in this country, as regards appearance. The paper and presswork are the best, and the *tout ensemble* is such as must delight any lover of books. And it is well that this should be the case, for the contents are such as every lover of history would wish to preserve. Rare documents are here reprinted and made accessible; obscure points are cleared up, and the facts recorded before the hand of time has been able to efface them, and biographies of notable men, whose lives are nowhere else recorded, are here given.

Cleaning and Scouring: A Manual for Dyers and Laundresses, and for Domestic Use. By S. Christopher. London & New York: E. & F. N. Spon.

This is a neat and cheap little pamphlet upon a subject of great importance to the ladies. It professes to be by a practical scourer, and a careful examination convinces us that it possesses those qualities which should commend it to those in want of instruction in such matters. It is thorough and reliable, and the directions are simple and easily followed.

The International Review. January and February, 1878. New York: A. S. Barnes & Co.

This journal begins its fifth volume with the bimonthly issue before us. It has now attained a high rank amongst our reviews, all its articles being worthy of careful study. In the present issue we have: Thiers—a sonnet, by Whittier; Elements of National Wealth, by D. A. Wells; The Second Harvest at Olympia, by Ernst Curtius, of Berlin; First Impressions of Athens, by E. A. Freeman; Sumner's Place in History, Poore; Money and its Laws, Prof. Sumner; Imperial Federalism in Germany, Baron Von Holtzendorff; Modern Love, Dr. Osgood; Count of the Electoral Vote, A. Stephens; Art in Europe, Hamerton. The only weak spot seems to be the reviews of American books. The books selected for review are certainly not the most notable in the current catalogues, and the so-called reviews of them are milk-and-water to the last degree of dilution. In marked contrast to this department is that of the English, French, German and Italian books, where the work seems to be performed with a due amount of ability and conscientiousness.

The Church Union.—This valuable journal grows more interesting week by week, the contributions of Drs. Duryea, Crosby, Burchard, Hyatt Smith and others, being always able and timely. The energetic publisher, Mrs. Grannis has achieved success in a field where many men of talent and experience have failed. The "Church Union" is positive in its non-sectarianism, preaching the doctrine of Union, and not of partisanship. Send for a copy to 22 Beekman street, New York.

The American Naturalist enters upon its twelfth volume with the old editorial management, but under new publishers, Messrs. McCalla & Stavely, of 237 Dock Street, Philadelphia, having succeeded Messrs. Hurd & Houghton in this department. The last issue contained a large number of interesting and valuable articles. Dr. Ward, of Troy, N. Y., who has hitherto so ably conducted the microscopical department, still continues to give the current microscopical news in a condensed form. The subscription remains the same, $4.00 per year.

Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

What I Know About "Handling" Objectives.

To the Readers of the American Journal of Microscopy:

It seems that the late controversy conducted by Prof. Hitchcock and myself yet liveth. Prof. Hitchcock, it is true, no longer attacks me in due form, but in the February number of this journal he gets after *you*, with the evident determination of proving the idea conveyed in Moore's couplet, to-wit:

> "The ghost of love may act anew,
> What love, when *living* failed to do."

Imprimis, I accept Prof. Hitchcock's "intention" and "design," conveyed in his foot note (see page 32), so far as I am personally concerned, but I do not propose to allow the gentleman to ride over facts as plain as the nose on my face, when he "assumes the judicial." I refer to his remarks on said page 32, foot note included.

Now, gentle reader, I submit that those of you purchasing objectives desire, first, to get the best possible glasses, and to use them to their fullest capacity—in short, to know all about then; and, secondly, that you having accomplished this much, it is no man's business what use you put them to. That's your funeral, not Prof. Hitchcock's.

Again, should you succeed in the possession of a fine glass, and have become expert in its "handling," you have an undoubted right to "fight it" to your heart's content against any and all competitors. *I* have thus fought mine two or three times a year; I rather like it. My crowning joy would be to take a whack at Prof. Hitchcock. Moreover, this fighting of objectives is by no means such a non-scientific pastime as he would lead you to infer. On the contrary, the louder the call on the opticians, the more generous will be their response. Young Spencer and myself fought objectives for a whole week last Summer, with the thermometer marking 100 degrees, and the pair of us found out something we did not know before! Scientific things, too, worth knowing.

Again, I have in my printed papers insisted on the vital importance due to "handling" objectives; I have furthermore stated in my Dunkirk address that these necessary manipulations cannot "be acquired in the ordinary routine of investigation," a fact so apparent that no one of that intelligent audience thought of controverting the statement.

This handling, my friends, not only concerns the microscopist, but also all who use instruments of precision. What would you think of the engineer who presumed to run a line of levels, without having previously, and when off duty, ascertained by special tests whether his level was in adjustment or not? The very idea of the engineer, on actual duty in the field, bothering as to the adjustments of his instrument, is too absurd to contemplate. The same holds good of those who use the various instruments found in the observatory.

Having then, my friends, your instrument, and having learned to handle it, I repeat that it's no man's business what you do with it; you may fight it, if you please, or lock it up in a bank vault if you elect—that's *your* funeral.

But again, suppose that you elect to put your glass to some purpose of scientific investigation, *then* it will occur that you are in position to make it put its best foot foremost—all of which is respectfully submitted, etc., etc.

Furthermore, for fear that my friend, the Professor may (unintentionally, of course,) have led you to surmise that I do little else than "fight objectives," I will tell you, *sub rosa*, that for the last two years I have not looked at a diatom except at the request of some visitor desiring to see the No. 20 of the Möller plate. On the contrary, the table on which I now write exhibits a goodly show of jars, containing injections of human kidney—malignant growths—and such; all of which are to be attacked in due time with my wide angles. I somehow feel assured that I have not in the past fooled away a moment over diatoms.

Once more, Prof. Hitchcock tells you that "a man who has worked for years with central light might feel lost if called upon to resolve a diatom. Well, I think so too. It's hard to tell *what* kind of microscopical work he would not feel lost at! Were I afflicted with *renal disease*, this much I know, that such a man would starve to death before he would get any of my patronage!

Prof. Hitchcock tells us too, as to the "proper method of using the screw collar." What he describes as "a very awkward plan" has been my constant practice for years. Any objective of Mr. Tolles (wide angled) such as he mentions would indeed be a curiosity. Mr. Tolles has never made the like for me.

To those of you, my readers, who feel interested in the manipulations of the microscope, and the "handling" of objectives, etc., etc., I improve this occasion to *advertise* that I shall shortly put the MSS. of a little book in the hands of Prof. Phin for publication. It will be full of the little "tricks," that I have found of assistance to me in my studies with the microscope. It will serve no higher purpose (scientifically) than to teach how to select a first-class objective, to "handle" it, and last, but not least, to *fight it.*

J. Edwards Smith, M. D.

Homœopathic Hospital College, Cleveland, O.,
Feb. 16, 1878.

The New Method of Swinging the Sub-Stage.

Ed. Am. Jour. Microscopy—In your February number, Mr. Zentmayer makes a personal attack on me, in regard to some recent improvements of the microscope, and threatens that he will prevent any one from "making, selling or using such parts as are an infringement of my (his) patented mode of swinging the sub-stage."

In reply, I would say that Mr. Zentmayer has no patent on swinging the sub-stage. His patent is: 1. For swinging mirror, accessories, etc.* 2. On the mode of attachment.

The only thing new is that the mirror is in line with the object on the stage. Then it is only the combination of the mirror and accessories, and the method of attachment that he can hold; and as I made the sub-stage to work around the object as a centre, three years before he did, it shows on the face of his patent that he cannot claim the swinging sub-stage. As Mr. Gundlach† has secured a patent on swinging the mirror and diaphragm without defining the place of the centre of motion, it seems that all Mr. Zentmayer can claim is the method of attachment, and he has to take his chances against any person making improvements. My mirror has nothing to do with the sub-stage, as they are each independent of the other, and they can be used together or separately, but still they both work on the same centre line, so that any person, by examining the sectional cut, can see that his threat, so far as it refers to me, is absurd and uncalled for. I had the sectional cut of A 1 and A B stands made expressly to show the internal improvement, and as Mr. Zentmayer is too well known as a practical mechanician to plead ignorance of a working drawing when he sees it, he must be simply playing a game of bluff.

Would it not save all further trouble if Mr. Zentmayer would just say what he did not invent? It does not make much difference what the improvement is, we cannot prevent him saying, "Oh, I made that; you will find one in Noah's ark."

I would return him my sincere thanks for his liberal offer to use the safety nose-piece, but unfortunately that is the same as every maker has been using for twenty years, with only the lever left off. He refers to page 12 of his catalogue about the centering stage. It is not like mine, as it has no back piece in which to work the screws, and it is evident that he could not get it to work successfully, or he would not have gone back to his inside ring. But for small favors let us be thankful.

W. H. Bulloch.

The Scale and Vernier Improvement in Stands.

Ed. Am. Jour. Microscopy—In the January number of your journal, from an article headed "A Correction," I quote as follows: "Prof. Smith has been misinformed; the President of the Dunkirk Society did not adopt Mr. Fell's plan, but devised it himself, as a part of a plan of a new microscope stand which he had constructed for him by Mr. Tolles."

The above is calculated to create the impression that President Blackham *originated* the scale and vernier device mentioned by Prof. Smith in the December, 1877, number of the journal; whereas such is not the case, it having been suggested long before he had it in mind, according to his own statement.

In his specification for "new stand," which he read to me previous to sending to Mr. Tolles, no mention was made of scale and vernier device, or anything similar, nor was it a part of his plan at that time. Several months subsequent to this, when spending an evening with President Blackham, and during a conversation regarding this stand, which he had informed me, was nearly completed and was soon expecting, *I* suggested the device, asking if he did not intend to have the scale, etc., attached to the new stand, pointing at the time to the side of a large Tolles microscope on his table. He stated he had thought of it before ("several days," he writes), and next morning wrote

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*Mr. Zentmayer claims, (No. 181,120, August 15, 1876): 1. The swinging mirror stem, carrying the mirror and its accessories, and having for its axis of revolution a line which intersects the optical axis, x x, of the body at a point in the plane of the object-slide, substantially as described and shown. 2. The combination of the mirror-stem and its collar with the flanged sleeve and rest, substantially as described and shown. 3. The combination of the shoulder bar, P, supporting the stage with the flanged sleeve and independent nut, M, substantially as described and shown.

†Mr. Gundlach claims, (No. 182,919, October 3, 1876, application filed August 10, 1876): 3d. Claim. The mirror bar D, mirror E D, and diaphragm G, combined and arranged relatively to the stage B, as and for the purposes herein specified.

Mr. Tolles to attach it to the new stand, claiming it as his invention. This was in October, 1877.

In April, 1876, however, I had suggested the idea to Prof. J. Edwards Smith, at Kingsville, and subsequently at Ashtabula, Ohio, and had also mentioned to co-members of the Buffalo Microscopic Club (Prof. D. S. Kellicott, I will mention), in connection with focalizing objectives, that it would obviate to a certain extent the inconvenience connected with focalizing immersion objectives, and, as I had known from experience, be of appreciable value in operating with medium power lenses, I had accustomed myself to observe certain marks on the limb in conjunction with others on the body or arm of my own stand, when my different objectives were in focus for ordinary thickness of slides, and instead of the usual custom of peering at a clear field, and straining the eyes, until the microscope tubes were moved through a greater or less space, and eventually focalized, I would simply have to notice the approximation of the marks referred to, when, on looking into the microscope, by another turn or half turn of the pinion, the object would be in focus.

It was from this use of my stand that the device suggested itself to my mind. Working microscopists may no doubt think it of sufficient value to attach to their stands, it adding but little to the complexity of an instrument; and if not for the purpose suggested above, for its apparent usefulness in the comparison of objectives, in measurement of working distance, and possibly for an approximate measurement of penetration, which could be obtained with a sufficiently fine scale and vernier.

For further reference to the facts of the case, C. P. Alling, M. D., Secretary of the Dunkirk Society, may be mentioned.

Geo. E. Fell.

Buffalo, N. Y., Jan. 14, 1878.

The Correcter Corrected.

Ed. Am. Jour. Microscopy—During the past years that I have been before the public as a writer, I have exercised due diligence to the end that assertions should stand the test of criticism from an intelligent public, and if I have ever felt *sure* as to the facts pertaining to any one matter, I certainly did so when I announced the device (scale and vernier) of Mr. Fell, which appeared in your last December issue.

Judge, then, of my astonishment when I read President Blackham's "correction" (?), in your January number! And now to the facts.

First, the President claims the device. He says that he "did *not* (italics his) adopt Mr. Fell's plan, but devised it himself, as a part of the plan of a new microscope stand, which he had constructed for him by Mr. Tolles. The object *held steadily in view* in the designing and construction of this stand," was such as required the device claimed by Mr. Fell. At least so he gives his readers to understand. Let us see.

About a year ago I was at Dunkirk, and read a paper before the Society. At this date the specifications for the new microscope had been in Mr. Tolles' hands for months, and the president was expecting it daily; in fact, he wanted it for the very evening that I addressed the Society. When I met the president at that date, his first words were, "I am so sorry that my stand is not *finished*. Mr. Tolles has written to say that it will not be finished for a month. It's too bad."

During this visit of mine, the president consulted me time and time again as to the new stand, and I emphatically affirm that all the minor details involved in its "get up" were discussed at length. He read me his specifications to Mr. Tolles; also, from his private letter book, his side of the correspondence; and, again, some of the letters received from Mr. Tolles. In all these there was not the most distant allusion to the device of Mr. Fell. Drive one stake down right here.

Delay after delay occurred, and in October, 1877, the said stand was not finished. At this date Mr. Fell visited the president, and the matter of the scale and vernier was discussed. Mr. Fell claims that he proposed having said device engraved on the new and forthcoming stand; certain it is that the *very next day after* this interview the president wrote to Mr. Tolles, instructing him so to do. Put another stake here.

In April, 1876, Mr. Fell suggested his scale and vernier device to me. A few months later he met me, and repeated his suggestion. A day or two after his visit to the president, I received a letter from Mr. Fell, in which he made casual mention of his visit, and of having proposed the scale and vernier device to the president.

These are the facts. I have no comments to make, further than to say mildly that I don't "stand corrected worth a cent," and that I still hold that I had good and sufficient reasons on which to base my article in your December number.

J. EDWARDS SMITH,

Homœopathic Hospital College, Cleveland, O., February, 1878.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of Feb. 1, Mr. Whitehead, the Vice-President, in the chair.

Some donations were received, and the following gentlemen were elected active members: Joseph Yates, C. F. Cox, Jay L. Smith, F. Collingwood, Chas. S. Shultz.

A paper was read by the Secretary on the use of salicylic acid in mounting. The experiments were principally made with marine algæ, different specimens of which were mounted in salicylic acid, glycerine, and carbolic acid, and after a time compared. Glycerine was found to be the best medium for general use, preserving the color more perfectly than either of the others. Carbolic acid preserved the color little better that salicylic acid. Salicylic acid not only removes color, but acts as a reagent. To make out certain structures, it is very valuable, but it is not well adapted as a general medium for mounting algæ. In his hands the method of Stodder for mounting algæ in balsam had failed entirely.

R. HITCHCOCK, Recording Secretary.

A regular meeting of the New York Microscopical Society was held on the evening of March 1, the President, Mr. J. D. Hyatt, in the chair. The minutes of the preceding meeting were read and approved.

Donations were received from several members, among which were some foreign deposits of diatoms, quite valuable and rare. Several new members were proposed. Prof. A. A. Julien read a paper "on a new mounting bottle for Canada balsam." This is an elegant and convenient piece of apparatus, from which the balsam can be expelled by pressure of the hand, and the quantity employed nicely regulated. A paper was announced for the next meeting describing a cheap and convenient case for collecting microscopic objects.

The subject of unjust postal charges on slides, which had been previously referred to a committee for consideration, was brought up and discussed. Prof. Phin made a few pointed remarks on the subject, and read extracts from a new bill proposed by Boston publishers. This bill is very advantageous for publishers, but for scientific men and those who desire to make exchanges, it may, and probably will prove very annoying and very unjust. He spoke of it as a "postal law for the discouragement of science," and compared the liberal interpretation of the postal laws of England with the narrow-minded and oppressive action of our officials here.

The law now proposed will exclude slides from the mails more rigidly than does the present one, and the committee was instructed to take immediate action in the matter.

R. HITCHCOCK, Recording Secretary.

New Jersey Microscopical Society.—This Society met Feb. 18, in the Geological Hall of Rutgers College, New Brunswick.

The Committee on Accounts reported the society in a comfortable condition financially.

Mr. Louis H. Noe, of Elizabeth, N. J., did some interesting work in micrometer measurements. Prof. Samuel Lockwood, the Secretary, exhibited slides of spermatozoa of Gallus Bankiva, also polyzoa and foraminifera from Madagascar, and some notably fine slides of double staining of Nelumbium luteum. The Secretary said that he had now gone nearly through the whole Nymphœaciæ, with the aid of Walmsley's admirable sections, and double staining, and he hoped soon to be able to present some facts respecting the physiology of this order of plants. He also invited attention to the Third Century of Prof. H. L. Smith's typical diatomaceæ, and pointed out the fact that, besides their general beauty, they were so rich in species, as this third century contained not less than sixty-one species of the Naviculæ.

The Society meets on the third Monday evening of each month, in Rutgers College, New Brunswick, N. J.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, January 17, with Prof. Wm. Ashburner in the chair. There was a good attendance of members present, and Mr. U. K. Arnold was introduced as a visitor.

After reading the minutes of the last meeting, Mr. Kinne announced the receipt of the "American Naturalist," and "Popular Science Monthly Supplement," for January; also the "Monthly Microscopical Journal," for November and December, in one number, the publishers of which stated that this issue would be its last, and made a proper announcement of the death of the editor of that Journal, Dr. Lawson. The scientific world will feel the absence of the "Journal," and regret the loss of so earnest a worker as Dr. Lawson.

Mr. Henry Edwards made some extended verbal statements regarding the laurel-wood borer, brought to the attention of the Society by Mr. Moore at a previous meeting, and exhibited a couple of boxes filled with carefully arranged specimens of various species of the group to which the beetle mentioned belonged. He also exhibited some of the fully developed insects comfortably impaled on pins, the destructive powers of which when in the larval form Mr. Moore had mentioned, and which Mr. Edwards had developed from specimens given him by Mr. I. C. Woods some years ago. He stated that its life history was already known, and the matter had been brought before the Society about four years ago.

Mr. Hanks presented the Society with two slides mounted by him with gold from sylvanite and abraded gold, from coin handled in the San Francisco Mint. The slides were accompanied by several samples of mineral mentioned in the paper which he read, illustrative of the subject of the divisibility of gold, and will be published in a future number. The paper opened up the subject so dear to all Californians—its mineral wealth—and some time was spent in discussing the matter in various ways. The slides and specimens were critically examined, and their peculiarities commented on at length.

It was announced that the next would be the annual meeting of the Society, at which time reports from the retiring officers would be received and a new board elected, which should, and no doubt will, call out a full attendance of members.

The annual meeting of the San Francisco Microscopical Society was held on Thursday evening, February 7, with a good attendance of members, and Vice-President H. C. Hyde in the Chair. Messrs. O. V. Lange, of San Francisco, and Dixon Provand, of Peru, were present as visitors.

By purchase there was added to the cabinet the Third Century of Prof. H. L. Smith's series of typical diatoms, which were found to be a valuable acquisition. When the series is completed, it will be one of the very best adjuncts to any Society's cabinet. The plan of placing twenty-five slides in a small racked volume is decidedly better than his previous methods.

The California State Geological Society donated two samples of Phosphatic Nodules, peculiar to the seaboard of South Carolina, and accompanied the same with the following extract from a letter of G. E. Manigault, the Curator of the Museum of Natural History, of Charleston, S. C.: "The nodules that are light colored are mined at a slight depth below the surface, and the dark colored ones dredged in the different arms of the sea and rivers between Charleston and Savannah. The percentage of phosphate of lime contained in these specimens is probably not over 40, but it is sometimes as high as 60 or 65, and when this latter is the case, the market value is proportionately increased. Since the exhaustion of the guano in the Chincha Islands, these phosphatic deposits of South Carolina have acquired great value, and are largely exported, as well as utilized at home, as one of the ingredients of the manufactured fertilizers that are much used now in agriculture. There is an interesting account of many of the vertebrate remains that are peculiar to these phosphate beds, in a recent number of the 'Transactions of the Philadelphia Academy of Sciences,' by Prof. Leidy, and you will see that he describes a variety of specimens, and he throws more light on the subject than any one has hitherto done."

The annual report of the President was necessarily deferred till the next meeting, in consequence of Prof. Ashburner being in Oregon, but the report of the Treasurer, Mr. J. A. Langstroth, was read, and showed that the Society was in a very flourishing condition.

Proceeding to the election of officers for the ensuing year, the result was as follows: President, Henry C. Hyde; Vice-President, C. Mason Kinne; Recording Secretary, X. Y. Clark; Corresponding Secretary, C. W. Banks; Treasurer, J. A. Langstroth. The best of feeling prevailed, and there seemed to be a unanimity of purpose to make the seventh year of the organization one of the most profitable from a scientific standpoint, and several papers on important subjects were promised for coming meetings.

State Microscopical Society of Illinois.—A regular meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, Jan. 25, 1878, James Colgrove, Esq., in the chair. Prof. Beach, of Louisville, Ky., was present as a visitor.

Donations reported were "Transactions of the Belgium Microscopical Society," for September, October and November.

The Secretary called attention to an egg which had been handed to him during the day; it had been boiled that morning, and when opened at noon it was found that a fungus had developed itself between the integument and shell. Handed to Prof. Stuart for identification, and to report on at the next meeting.

Prof. E. J. Hill, of Englewood, read a paper on "Mosses," clearly explaining their method of growth, development and reproduction; he had prepared many photographs illustrating his subject, which he used with the sciopticon. He also showed many mounted specimens of mosses from his herbarium. H. F. ATWOOD, Secretary.

A regular meeting of the State Microscopical Society of Illinois, was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, Feb. 22, 1878, President Fuller in the chair.

Donations reported were "Transactions of the Belgium Microscopical Society," for December.

The President announced that a reception had been tendered to the Society by Mr. E. W. Blatchford, and the date had been fixed upon for Friday evening, March 8.

Mr. J. G. Langguth called attention to some muscle of pork, from which he had prepared some slides, to show how badly it was affected with trichina; it was from Ohio, and had caused several deaths in one family.

Mr. W. H. Bulloch exhibited quite a curiosity, in the shape of a copy of the first English translation of the works of Leeuenhoek; the work is profusely illustrated.

Prof. E. B. Stuart read a report on the fungus found in the egg, which came before the last meeting. His report is as follows: "The enclosed tracings are from camera lucida drawings of the fungus growing on a recently boiled egg, presented at the January meeting of the Society. The egg, when broken, was found to have become the nidus of the plant, which had developed itself in small spots of a deep olive brown color. A hasty examination led the writer to believe it a new form belonging to the order Dematici. Its manner of growth was somewhat unfavorable for examination, as the flocci, or fertile threads on which the spores are developed, could not be distinguished through the mass of dark spores which covered the aspices. The spores were simple, globose, olive-brown in color, apparently disposed in moniliform chains, and very small, hardly exceeding 1-6000 inch diameter. In order to obtain it in a more favorable condition for study, some of its spores were placed in Pasteur's fluid, with precautions to prevent the growth of ordinary moulds, and after about seventy-two hours were found to have fruited abundantly, presenting an appearance which may be described as follows: Mycelium not septate, fertile threads erect, compressed in places, dark, simple or branched irregularly, not septate and producing chains of dark spores, irregular in shape and size, but generally globose and measuring from 1-12000 to 1-6000 of an inch in diameter. In five days the fertile threads had become quite numerous but were very small, none were observed which exceeded 2-1000 of an inch in height, and with a single exception none were septate. At the present date the cover of the growing slide is covered with the germinating spores, some of which are seen to be septate. A word as to the position of this among the moulds will perhaps be expected. Although by far the most minute the writer has ever seen, it can be safely placed among the Dematici, an order readily distinguished by its black or dark fertile threads. It does not in the writer's opinions fall in with any genus of that order described in "Cook's Handbook," although the arrangement of the spores on some threads is not unlike a "Haplographium," while on the other hand its non-septate threads exclude it from this genus as well as from cladisphorium, in which the threads are jointed, and the spores are finally septate. The most common species of this genus, "Cladisphorium herbarium," is, however, notoriously variable, and there is a possibility—which is strengthened by the late appearance of septa in some of its spores—that further cultivation may show it to belong to this species."

The meeting now adjourned to listen to an excellent paper on Bacteria, read by James Colgrove, Esq., at the conclusion of which the subject was discussed by various members, Professors Delafontaine and Hill expressing their views as to the relation of bacteria to some forms of disease.

H. F. ATWOOD, Secretary.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of mausanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Wanted, in exchange for a number of fine slides, the polarizing apparatus for a first-class stand. Address F. F. Stanley, 40 Pearl St., Boston, Mass.

Gomphonema germinatum, a pure gathering of "Challenger" soundings, Globigerina, etc.; also, 8 European earths. Good marine and guano diatoms, unmounted, wanted in exchange. W. M. Paterson, Westfield Terrace, Loftus, England.

Mounted or unmounted crystals of tartaric, oxalic, red prussiate, chloride and bichromate of potash, for other objects of interest. Address H. B. Hargreaves, Garnerville, Rockland County, N. Y.

Slides of black rust on wheat stalk, opaque and transparent; stained fertile frond of Adiantum pedatum, etc., for other mounted objects. Address F. H., Drawer 85, Cherokee, Iowa.

Slides of spores of botrychium, and fossil diatoms from Bow, N. H., for other mounted objects. Lists exchanged. Wm. W. Griffin, Lynn, Mass.

Slides of cuticle of larva of Macrosila Carolina, showing crystals, in exchange for other objects. E. A. Burdick, Pension Office, Washington, D. C.

Palates of mollusca, a great variety, mounted or unmounted, in exchange for mounted slides of interesting objects or good material. C. M. Vorce, 164 Lake street, Cleveland, Ohio.

Slides of Arachnoidiscus Ehrenbergii, *in situ*, on seaweed from Santa Cruz, Cal., and Aulacodiscus Kittoni (transparent), for other mounted objects. C. Mason Kinne, No. 422 California street, San Francisco, Cal.

Mounts of Uric Acid (natural urinary deposits) in exchange for other mounted objects of interest. Address W. J. Weeks, Homœopathic Hospital College, Cleveland, Ohio.

Specimens of the marbles, granites and minerals of Vermont, in exchange for Western minerals, or good fossils; minerals and fossil woods from the far West specially desired. Dr. Hiram A. Cutting, State Geologist, Lunenburgh, Essex county, Vt.

For exchange, transparent injections, equal to finest English slides of Thymus and Thyroid glands, stomach, bladder, kidney, mesentary, intestine and tongue of cat. J. T. Joslin, Newburgh, N. Y.

Wanted, in exchange for diatoms from northern Wisconsin and Michigan, any well-mounted objects; marine diatoms preferred. W. H. Titus, M. D., Shawano, Wis.

Slides of various kinds of fertile fern fronds, Indian corn, deutzia, citra odora and other leaves, decolorized and stained, exchanged for other good microscopic objects. C. Blasdale, M. D., Jericho, Queens County, N. Y.

Polyzoa with "bird's heads," foraminifera, polycystina, holothurian plates, synapta anchors, chirodota wheels and young; spicules of sponges and gorgonia, etc., in exchange for foraminifera, pathological, anatomical and vegetable preparations. F. M. Hamlin, M. D., Auburn, N. Y.

Publisher's Department.

Angular Aperture of Object-Glasses.—In a recent communication to the "English Mechanic," Mr. F. H. Wenham says: "120° is perhaps the maximum of angle that has ever been reached in the microscope object-glass. I have object-glasses in my possession which will admit light to near 180°, but the angle or axial pencil of which, correctly measured, does not reach 100°; yet these glasses easily resolve the most difficult tests known."

Given Away.—A superb pair of 6x8 chromos, worthy to frame and adorn any home, and a three months subscription to "Leisure Hours," a charming 16-page literary paper, full of the choicest stories, poetry, etc., sent free to all sending fifteen cents (stamps taken) to pay mailing expenses. The publishers, J. L. Patten & Co., 162 William street, New York, guarantee every one double value of money sent. $1,500 in prizes, and big pay given to agents. Write at once!

A Call to the Telephone.—Several devices have been suggested for calling attention to the telephone, when it is desired to open conversation. Most of them are clumsy, and some require the attachment of a galvanic battery. One of the simplest is described and figured in "Nature." It is the invention of W. C. Rontgen, and consists principally of a tuning fork (Ut 4), one of whose prongs is brought close to one of the poles of the magnet in the telephone—preferably to the pole farthest from the telephone disk, a straight or "bar" magnet being usually the kind used in the instrument. The tuning fork is mounted on a sounding board. Similar apparatus is provided at both ends of the line. To sound the alarm, in order to give a call of the telephone, it is only necessary to draw a fiddlebow across one of the tuning forks; the other, at the further end of the line, responds with a note loud enough to attract attention throughout a large room.

A Useful Little Article.—Very few persons can write a signature so that it can be read. We involuntarily get into the habit of writing our names rapidly, and the result is that our correspondents cannot read them. Attempts have been made to obviate this difficulty by means of stamps, but hitherto stamps, if good for anything, have been clumsy, bulky, and the very reverse of portable. The latest thing of this kind, however, is a pocket stamp, which can be attached to a pencil. It is neatly mounted in a nickel-plated case, and protected by a cover, and the rubber stamp gives a clear, sharp impression, which can never be misinterpreted. Another advantage is that they are very cheap. Address Scott & Co., 291 Broadway, New York.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, APRIL, 1878. No. 4.

Hints on the Selection of a Physician's Microscope.*

DURING the past twelve years, the author has received hundreds of letters from as many individuals commencing the study of the microscope, desiring such information as to the best way of making an investment as may pertain to the selection of stand, objectives, etc. The said letters have met with a prompt response, and, as has before been stated, perhaps no two of these have been alike. In each and every case there has been some dissimilarity of circumstance, or, on the other hand, we have suffered some change in our own views. Be all this as it may, the experience of the last two years enables us to speak more precisely to the point than before, and we now endeavor to respond to the interrogatory, "What shall I procure for an outfit?" There can be no general rule that will apply to all. Let us take the following as a typical letter for consideration:

"*Dear Sir*—I have read some of your contributions to the AMERICAN JOURNAL OF MICROSCOPY. * * * * I am a physician of ten years practice; am located in a town of some ten thousand inhabitants. I am satisfied that I ought to know enough about microscopy to enable me to examine intelligently urinary deposits, cancerous growths, etc., and to this end do I propose to purchase the necessary equipment. Any information that you may be pleased to give me will be with pleasure received," etc., etc.

Now, I would answer this letter, and did answer it, thus: When you buy a stand, get one that you will have no occasion to sell at a ruinous sacrifice. I recommend that you purchase one of the cheap and moderate priced instruments, and at the same time one that will do any and all work. Such a stand ought not to cost, with one eye-piece, more than $35 (and such are described in this little book). Now, as to objectives; you can do all the work named with a one inch of tolerably low angle, costing you, say, some $7; and a real good 3-10ths of 70° aperture, which will cost you, say, $11. The chances are, however, that as you become familiar with the use of the instrument, thereby learning its value to you in your daily professional practice, you will feel an inclination to dip somewhat deeper into the problems which will most assuredly surround you. In your examination of urines, you will get glimpses of bacteria; you may meet with structures which you are almost assured are "pale hyaline" tube casts, and you naturally desire a little more amplification and definition thereon, to enable you to pronounce with certainty. In fact, you now want such a glass as a dry 1-4th of 110° or 120°, and adjustable. Now, to use this glass to advantage, you have first to become familiar with its manipulations. It will be requisite that you arrive at some knowledge of this before such an objective can be of much avail to you. Now, if you purchase the 1-4th recommended, you will still have room for the employment of the 3-10ths, but you will have to study the use of the 1-4th, just the same as if you had never seen an object-glass; hence I had rather recommend that you purchase the 1-4th at the start, and thus get *early* accustomed to the use of adjustable glasses; and in this latter case it will almost assuredly occur that you will eventually desire to employ glasses of the widest apertures, and the experience you have gained with the use of the 1-4th will be of the utmost value to you. Moreover, the 1-4th, too, will continue to be a useful intermediate glass.

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*Taken from the advance sheets of "How to See with the Microscope." By Prof. J. Edwards Smith. New York: Industrial Publication Company.

And thus, in replying to all my correspondents, I recognize the importance that one and all shall early become acquainted with the manipulations of adjusting glasses. To accomplish this they must use objectives of the first class and which are reliable, *i. e.*, which will respond promptly to change of collar adjustment, keeping well in mind the importance of buying nothing to be discarded, or thrown out of use in the future. In the case under consideration it will happen, in nine cases out of ten, that in less than two years the buyer will feel that he needs a first-class inch, or perhaps a 2-3ds, in which event the old inch will be of great service as a sub-stage condenser, providing that the stand has been selected with this end in view.

It may further happen, in truth it will be likely to happen, that, in the course of one or two years, my correspondent will either push his own observations, or desire to keep pace with those of others, and over structures of the most delicate and "difficult" character, and now he will need a 1-6th or a 1-10th, of the widest possible aperture. Allowing this to occur he will have expended but $110, which is less than the usual cost of a nominally first-class 1-16th, and all the glasses on hand will still be of service. Besides all this, he is well armed and equipped for any work requiring powers from 50 to 5,000 diameters, and there will be no objectives on hand that will not be worth their cost.

On the Measurement of the Angle of Aperture of Microscope Object-Glasses.

BY F. H. WENHAM.

I HAVE long held the opinion that no method of measurement hitherto used has given any results at all approaching to accuracy, and in many instances the angle of aperture of microscope objectives has not reached even to half the number of degrees attributed to them. The mistake arises, as I have repeatedly urged, from the entrance of oblique pencils or rays extending in a direction away from the central or axial one, so that it is the angle of the extreme rays at the margin of the field of view that we measure, instead of the angle proper.

In order to confine the apex of the cone or pencil of rays to one central point in the axial focus, I proposed that the sector measurement should be performed with a very narrow slit or minute perforation set precisely in the focus; but this, though right in theory, was found to be difficult and impracticable for high powers, as even the narrowest slit that could be used must have a diameter causing an error of angle to be indicated greatly in excess, and it was impossible to assign the exact limit of angles because no distinct image could be seen through a minute slit. In order to obviate this objection, and obtain a result that should be consigned to an exact centre line, a half screen bisecting the field in the focal plane was next proposed, the screen to be shifted alternately during the measurement. But this plan was abandoned as altogether fallacious, for it is the property of a lens that every open point on its working surface admits a ray from every portion of the field of view. The effect by obscuring the alternate halves is simply nil, the sum of the two measurements being equal to that of the entire uncovered lens. I mention this because Drs. Nickolls and Bull suppose that as the result corresponds nearer with the open measurement, it must be considered accurate.

I next proposed to eliminate the marginal pencils of the field by means of a small stop set in the focus of an eye-piece adaptation. This has also been found to give unreliable measurements, but still it affords no disproof of the accuracy of the principle to which I have called notice. Of this I now give additional demonstration.

I selected a 1-5th of fine quality, which worked as an immersion. This position prevents quibbling concerning various positions of adjustment. The aperture, as measured by the sector through a slide, with water between that and the front lens, was 120°. The focal distance as immersion was .041 (I use a Zentmayer form of stand, which is fitted with a micrometer scale and vernier directly on to the fine motion slide, so that depths can be measured very accurately). The diameter of transmission on the surface of front lens was .07. This is ascertained by allowing a drop of milk to dry on the front, and measuring the diameter of the light spot from parallel rays, entering the back, using a low-power object-glass and micrometer eye-piece for the measurement.

The field of view included a diameter of .03 on a stage micrometer. Now, having the exact focal distance from the surface of the front lens as a starting point, it remained first to ascertain what were the apparent apertures taken through various sized stops set close on to the front, having definite diameters that could only admit the base of a cone of rays, from an angle taken from the axial focal point, up to a known diameter of stop. The arrangement that I use is a form of adjustable slit, consisting of two strips of very thin platinum foil. One piece is cemented on to a parallel slip of thin plate-glass, which is made to slide under two staples by a micrometer screw acting against a counter spring. The fixed strip of foil is attached to one of the staples, so that when the screw is quite home, the edges meet. The various widths at which the instrument was set were measured under the microscope with eye-piece micrometer. Having got the desired width, the object-glass to be measured was attached, and the body of the microscope lowered till the slit came in contact with the front lens, a drop of water having been placed over the slit, to prevent undue refraction and obtain more light.

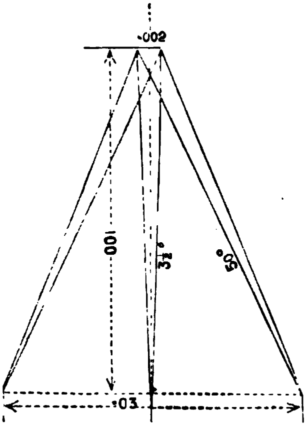
The apparent angles included by these different limiting edges or stops were measured by the usual sector method of rotating the microscope on a turn-plate, graduated into degrees, and ascertaining the vanishing point of a distant light, or preferably by means of an examining lens at the eye-piece, so as to observe the disappearance from the field of an actual image.

The real or true angles were estimated from the distance of the focal point, up to the known measure of the edges of the stop. Avoiding fractions of degrees, the following table gives the comparative results:—

Working diam. of front lens.	False aperture.	True aperture.
·07	120°	89°
·06	118°	80°
·05	116°	70°
·04	103°	58°
·03	88°	45°
·02	68°	31°
·01	59°	16°
·005	53°	8°
·002	50°	3·5°

The last item, with a stop 1-500th of an inch in diameter, indicates an aperture of 50 degrees by the usual methods, whereas the true angle is only 3½ degrees—an error being shown in excess of more than fourteen times.

The annexed diagram demonstates the cause of this error. The central angle shown is the true aperture assigned by the width of the small stop at the base. The oblique angles represent the pencils including the field of view, and showing light, or an image, in the eye-piece up to an angular range of 50°. As I have so repeatedly urged, it is these outside rays which are superadded to angle of aperture taken by the usual measurement, and which are the cause of erroneous indications greatly in exces of the true angle.—*English Mechanic.*



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The Divisibility of Gold.

A paper read by Prof. H. G. Hanks before the San Francisco Microscopical Society, Jan. 17, 1878.

HAVING recently had occasion to refer to statistics showing that gold coin loses an appreciable amount even in a single handling, and being desirous, in connection with my investigations, to examine microscopically the gold dust resulting from such abrasion, I asked Mr. L. A. Boynton, of the United States Treasury, of San Francisco, to brush out the wooden tray in which large sums of gold coin are daily handled, and when he had accumulated sufficient to see the gold, to send it to me. He has kindly complied with my request, and I am able this evening to call your attention to some interesting facts which have developed themselves in the examination.

I have prepared a slide for the Society's collection, in which the gold is mounted dry, after first partly removing the impurities with which it was mixed. It will be seen, however, that there still remains coal, sand, fibres of wood and cotton, hairs, etc. In washing out the extraneous matter, the finer particles of gold floated on the surface of the water, and I found it impossible to cause them to sink, although I tried every plan I knew of. This experiment would seem to prove the truth of the oft-repeated statement of miners, that much free gold escapes them from this cause.

On examining the slide under the microscope, it will be seen that the gold is invariably in the form of scales, and much resembles the natural gold scales found in the beach sands at Cape Blanco, except that in the latter the edges and faces of the scales are rounded by attrition in being washed about by the waves.

It has been a source of wonder to gold miners that nearly all placer gold is found in flat pieces. Some ingenious theories have been advanced to account for it. The sample I present this evening would seem to indicate some law which governs the form of its fragments. I admit I cannot clearly understand how rounded masses of metal like gold coin should react on each other mechanically and produce flat fragments, as shown in the specimen.

To give an idea of the size of the particles of gold, I have measured some of them in decimals of an inch, and I find them to vary from .003x.001 to .0425x.0235.

I have also measured a large number of the gold scales from Port Oxford, and find an average of .0095 mean diameter by .00374 mean thickness. The samples were washed ashore from the beach sands found a few miles south of Cape Blanco, on the coast of Oregon. Ten of the scales, selected at random, and melted into a button, weighed 0.0021327 grammes. From this weight I have calculated the number of such scales which would be required to make up the weight of an ounce Troy.

If I have made no mistake in my figures, the number should be 142,468, and yet these gold particles are large as compared with those usually found in quartz.

In collecting gold from quartz by amalgamation, it has been found that in most parts of California, any mine producing rock that will yield by simple milling process ten dollars to the ton of 2,000 pounds, and in sufficient quantity to keep a mill constantly running, will pay well to work.

Most of the best paying mines in California do not produce rock in which gold is visible to the naked eye. It requires long search to find a piece of rock showing free gold.

When the tailings of a quartz mill are examined microscopically, the importance of reducing the ore to a state of extreme fineness will be apparent, for if the gold is not absolutely free it cannot be collected by mercury.

Recent investigation naturally leads to the opinion that gold in a state of extreme division is omnipresent in the earth's crust. T. Sterry Hunt, in his work, "Chemical and Geological Essays," quotes Sonstat to show that the sea water on the British coast contains, besides silver, gold in solution. estimated by him to be about one grain to a ton of water. Mr. J. Cosmo Newbery, Chemist of the Geological Survey of Victoria, Australia, has made some very interesting investigations bearing on the divisibility of gold, He found that the water in certain gold mines contained gold. The timber used to support the mine was carefully assayed, and in nearly every case was found to contain gold. R. Brough Smyth, Chief of the Survey, came to the conclusion that the gold was precipitated from solution.

Mr. Newbery had reason to believe, from examination of specimens, that gold was being deposited in many mines. He thinks, however, that finely divided gold is held in suspension in mine water, but not in solution. A sample of mud deposited from mine water of a mine on Hasler's line of reef, Sandhurst, was examined by careful washing, and the heavier particles were found to consist of auriferous pyrites and free gold. The particles of gold were large enough to be recognized by the microscope. They were in irregular flattened grains.

Dr. Oxland, who was formerly manager of the Borax Lake Company's works, has given a very interesting account of the deposition of gold with cinnabar, free mercury, sulphur, boracic acid, silica, etc., at the sulphur banks situated on the margin of Clear Lake. He says: "These phenomena present indubitable evidence of the volatility of gold and silver, mercury and iron, in presence of aqueous vapor, associated with sulphuretted hydrogen, carbonic acid and boracic acid."

Some years ago, in Calaveras county, an old furnace—used in roasting pyrites preparatory to treatment by chlorination—was torn down, and the roof was found to be coated with gold. A specimen is preserved in the museum of the University of California. Here is a proof that gold is volatile at a comparatively low temperature. It has long been known that it is volatile at a high temperature, and advantage is taken of this fact in the purification of platinum.

On the Pacific Coast, gold is found in the most unexpected places. There is scarcely a formation which does not contain gold in greater or less quantities. It is also found associated with minerals not usually considered its associates.

To illustrate this fact, I have brought, for inspection, several remarkable specimens.

1. Gold in pyrolusite.
2. Gold in steatite.
3. Gold in calcite. In this specimen the gold is deposited on the wall-rock of the mine; apparently by the same agencies which deposited the calcite.
4. Gold on pyrites. It will be remembered that I exhibited a similar specimen at a former meeting, and called attention to the globules of gold which seemed to be squeezed out of the crystals of pyrites; or to have been deposited on their surfaces in a manner not easily explained. The specimen I have brought this evening is more remarkable than those formerly shown.

I have long believed that the gold in sylvanite, nagyagite, calaverite, and other telluric minerals, was a mechanical mixture, and not chemically combined. Experiments I have made from time to time have convinced me that my opinion was correct. I have prepared a specimen of telluric gold, from Sunshine, Colorado, which is worthy of your attention. You see that the gold is in a state which would preclude the idea that it had been chemically combined with the tellurium; in which case the gold would have been an amorphous powder rather than the regular semi-crystalline form shown. The specimen has been repeatedly boiled in nitric acid, by which the tellurium has been dissolved.

It must be admitted, from the experience of the last twenty-five years, that gold exists in minute quantities in many rock formations which will not pay to work. On the other hand, many mines which will scarcely pay at the present time, will become productive as our quartz-milling machinery is improved. Much gold is lost in California by unskilful milling.

Although the modern quartz mill is a marvel of mechanical skill and ingenuity, and does its work rapidly and well, yet it has not reached perfection. The problem for the future inventor to solve will be to construct machinery which will reduce the rock to an impalpable powder, to set the gold free, and to collect it without mechanical loss, either of gold or mercury.

Polarization by Refraction; also Other Special Forms of Oblique Illumination.

BY L. R. PEET.

ONE evening, a little over a year ago, I was sitting at my instrument, examining a slide of miscellaneous fossil objects, *Actinocycli*, *Heliopeltæ*, *Coscinodisci*, etc. Having used the direct pencil for some time, and perceiving that the charm of that kind of contemplation was waning, it occurred to me to see how my knowledge might be increased by intentional and very careful casting of shadows from the neat little prominences into the smooth valleys below. I soon found my interest in the particular group of diatoms in the field so enhanced that I addressed myself in earnest to the shadow-casting, and kept it up for two or three hours, first from the right, then from the upper, or, so to speak, north side; afterwards from the lower; finally from the left, or side towards the lamp.

The left hand effects proved much the best, and I became so intent upon my occupation, holding the mirror constantly in both hands, that I lost perfect control of my muscles, and one of those ill-timed, quite undesigned jerks, which at critical moments do damage, and are sometimes emphatically rebuked, carried the mirror so far to the left as to leave the field entirely dark. A long breath was drawn, the hands rubbed together, and the mirror grasped again. The next instant a similar unpremeditated twitch of muscle ensued; but, lo! a revelation! Two large *Actinocycli*, in the middle of the field, flashed out with a brilliancy of beauty exceeding any previously impressed upon my retina. It was as if each of those wonderful frustules had been suddenly lighted up at a thousand points by as many minute calcium lights, the colors red, green, and gold, being about equally represented. Floating near—all seemed in a kind of nether midnight sky—one *Heliopelta* showed its slim triangular divisions in alternate green and gold, with a bright yellow rim, and marginal projections, each in three colors. A *Coscinodiscus* on the other side was in pure luminous yellow, with faint green in the centre.

Being of a philosophizing turn, I presently waved off the poetical phase of the matter, and asked, Whence this? A confident reply came at once: These objects are made thus beautifully radiant by polarized light. But how such peculiar ether motions got there, was not so readily answered—was not, indeed, answered at all for several months.

Ordinary black ground illumination was a familiar thing, and I at first compared what I had discovered with that. It at once appeared that there was a difference. No mere black ground illumination ever gave even an approach to the brilliancy and variety and most delicate distribution of colors shown by the new light. Only the polariscope could do it, and that failed to distribute the colors so minutely. Diffraction was once suggested by an observer; but the idea was put suddenly out of the question by seeing that the ground was entirely black—no hint of tint of any kind—and that all parts of the field were equally illuminated. Furthermore, a change of position in the mirror gave alternation of supplementary colors.

The only explanation which recommended itself, by its plausible aspect, was the following, based upon the discovery of Fresnell: He has demonstrated that light, on passing through a plate of glass, is brought by refraction to the circular stage of polarization, but that this is done only in case the pencil impinges at the angle of 57° with the surface of the plate. Careful examination showed that the light struck the lower surface of the slide at about that angle. Why should the light, then, not be brought to the circular stage on reaching the upper surface? That would explain the black ground, the circular stage being the same as that shown at the crossing of the tourmaline crystals. A perfect result of this kind would depend upon the perfect homogeneousness of the structure of the glass. A slide of inferior quality, especially having twists in its internal structure, renders a good black ground impossible. A persistent, vague illumination, sometimes from no particular point, at others quite manifestly from right or left, or some other point, spoils the field. If the slide be of good quality, this never occurs. The black ground comes over the field with a sharply defined front, and however the slide may be moved about, the perfect absence of light continues.

Of course the main body of the pencil must be excluded from the object-glass. Only the thinnest possible shaving, as it were, is taken, and that from the side nearest the lamp, so as wholly to avoid what may be called the crude, or unpolarized light.

A small portion of the polarized light passes through the slide; and if there be no object in the field, these ether motions go on up the objective to the eye, making no impression on the optic nerve. There being an analyzing object present, the wavelets in whose path it stands, strike it. According to the power of analysis possessed by the object in its external or internal structure, the light is forwarded to the second elliptical stage, in which alone colors are shown. As the object which has the power of analyzing, has also the power of polarizing, we may, perhaps, suppose that a second polarization and analysis take place; and this may account for that feature which first strikes the observer familiar with the polariscope, namely, the extraordinary delicacy of distribution of color. The colors are of every conceivable shade, and being luminous, no shadows are cast, only darker shades of color are presented. A portion of any part of the surface of the pencil will give similar results; but one from the lamp side gives, as we might *a priori* infer, decidedly more pronounced results, the refraction on that side being more marked.

A description of my way of doing the thing comes properly in here.

The lamp, a strong broad-flamed one, without a screen, and about thirteen inches high, is placed fourteen or fifteen inches from the instrument, the latter standing at right angles to the former, and to the right hand; to the left would probably answer just as well. A slide of analyzing material—of crystal or diatoms—is put on the stage and focussed as usual by direct light. The mirror is then carried slowly to the left, being occasionally depressed by the left hand, so as to keep the field illuminated as long as possible. At the extreme verge the black ground will show itself, passing from the side towards the lamp to the opposite side; and as it goes over the field, the object seems endowed with the power of giving out light of its own. By very careful adjustment of the mirror, this radiation is brought to its maximum, the colors being generally most distinct at that point; yet sometimes they are better shown by slightly subduing the light.

Without a condenser, the effect will be comparatively feeble. This has probably led to the failure of others to make it seem of value. A strong condenser must be applied, after the best result with the mirror alone has been reached. I imagine the shape of the condenser has something to do with the effect. I use a concavo-convex lens (best bulls-eye), so mounted that it can be carried under the diaphragm, and adjusted, concave side up, close to the latter, the largest aperture being employed, adjusting toward the left hand. Besides, the mirror should be large and capable of easy adjustment in any direction, the concave side being used. My mirror can be lowered, and I always place it at the lowest point on its rod.

A ½-inch objective, with a B ocular, is the best average power, so far as I have observed.

The higher powers shut out too much light, and the lower admit too much—the brilliancy not being favorable to minute scrutiny, however pleasing to the eye. The object must be extremely thin, otherwise the thicker portions will send out a kind of glare, obscuring the parts adjacent. All fossil objects should be mounted in balsam or damar, as well as all cretaceous material. Crystals may be dry; indeed, any medium, except air, so far interferes with them that when it is possible to preserve them dry, they should by all means be thus mounted. Butterfly scales (dry) of all kinds are excellent objects. All parts of insects which the polariscope transmutes are suited to this light. Living animalcules are wonderfully defined, and often rendered exquisitely beautiful. The hairs of plants—the deutzias, elæagnus, solanum mammosum, and the like—are changed into apparent crystals, gleaming with lustre, and gaining, as every suitable object does, a definition of minutæ not attainable by any other form of illumination.

It is not improbable that all the conditions of complete success are accidentally present in my instrument; and that with many of a different pattern (this I know to be true of Beck's and Zentmayer's) all the conditions are not found; hence what seems to be a thing of some practical importance will remain unutilized, until instruments are constructed with a view of obtaining the results named. That this can be done is very certain.

As to the value of these results, I will cite the remark of an experienced microscopist, who was at my house a few weeks ago. Said he: "The effects are somewhat *different* from those of the polariscope; yet from what I have seen here this evening, I should say the difference is in favor of your form of illumination."

In conclusion, I will mention a form of radiation which I have found very valuable. It occurs just before the black ground makes its appearance. The light at that moment seems to come from above the slide. A very nice adjustment is necessary, in order to get it at its best. The slide takes on the appearance of a buff ground, the objects lying about upon it; and they are so equally illuminated that an almost supernatural distinctness prevails. I get this effect with my highest power (1,200 diameters) and find it very favorable to all kinds of resolution. My strong condenser is always present.

One thing more occurs to me. With a Gundlach 1-2 inch objective, I am able to polarize all kinds of plant crystals, often with startling beauty, and have the field lighted up at the same time. There is an angle, very difficult to hit, at which the light is put in such a state as to be analyzed by crystals of that kind. I think it is about that of 50° from the line prolonged through the axis of the object-glass. That it is not the fault of the objective is shown by the perfect definition, even where the color is most distinct.

I think that if any reader should be sufficiently interested in the foregoing to criticize, and offer some other and better explanation of the phenomena described, the rest of us would be glad to have him do so.

Baltimore, Jan. 24, 1878.

On a New Mounting Bottle for Canada Balsam.

THE most important requisites to the working microscopist, in the vessel which holds Canada balsam, are the following:

First—Convenience in handling and delivery. This includes a form suitable to the hand, and portable; ability to deliver the mounting medium quickly, from a small drop to any quantity, and cleanliness during rapid work.

Second—A sufficient capacity to hold a quantity of the balsam adapted to the needs of the mounter. A small apparatus suited to the occasional use of an amateur, would be entirely unfit for continuous mounting.

Third—Permanence in good order. This involves a suitable simplicity of construction, in order to facilitate easy repairs whenever necessary.

Fourth—Protection of the contents from impurity. This excludes any arrangement by which the entire contents are exposed to the air during the delivery of even a small quantity, or by which an examination of its continued transparency is prevented by the opacity of the material of the vessel.

Lastly—A convenient arrangement for replenishing.

Three kinds of apparatus have been proposed and are in general use. The first consists of the flexible tin-tubes of the artists, from which the balsam is expelled to any extent by pressure. Though convenient for work on a small scale, they are objectionable on account of their cost, the occasional annoyance produced by the cementing of the cap, and their small capacity. The second consists of a tin can for the common glass-capped bottle, with ground joint, enclosing a glass rod. The inconvenience in delivery, the almost inevitable smearing of the exterior by drops from the rod during rapid work, the conseqent cementing of the glass cap, and the exposure of the whole contents of the bottle to the impurities in the air at every moment of use, are serious objections to this apparatus, except in experienced hands.

A third device, the best of all, proposed by Dr. Carpenter, consists of a glass syringe, with its nozzle slightly bent. I have found this apparatus the most convenient of the three for extensive mounting, when made with sufficient capacity, and with a leather packing to the piston in place of the usual rubber or cotton yarn. In practical and continuous use, however, the syringe requires to be kept warm, by lying upon one end of the mounting table, to render the piston movable; the upper part of the tube above the piston, is apt to become smeared with balsam, which hardens and attracts dirt; and the consequent irregularity in the movement of the piston, the inconvenience in re-filling with balsam without introducing impurity, and the tendency to roll off or to roll over with the nozzle downward, sometimes occasion considerable trouble, uncleanliness, and loss of time.

About two years ago, my friend, Prof. H. C. Bolton, of Trinity College, Hartford, Conn., on being advised of the objections to the forms of apparatus hitherto in use, at least for extensive and continuous mounting of preparations in Canada balsam, suggested a new form of bottle* for the purpose, on the principle of the common wash-bottle of a chemical laboratory. With the modifications suggested by further trial, a satisfactory experience founded upon its constant use since that time, induces me to offer the following description to the attention of microscopists.

A bottle, sufficiently slender to be clearly clasped by the hand, is fitted with a good cork or rubber stopper pierced with three holes. Each of these holes is furnished with a tube of rather stout glass, about

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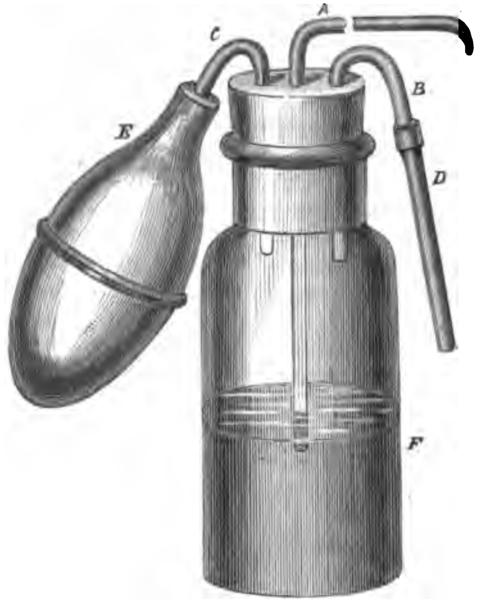
*Dr. Beale has already proposed a little apparatus on a similar principle—his glycerine dropping battle. ("How to Work with the Microscope," Plate lvi, Fig. 342.)



BOLTON'S MOUNTING BOTTLE.

three-sixteenths of an inch in diameter, and open at both ends. The delivery tube in the centre reaches nearly to the bottom of the bottle, and is bent above the stopper at an angle a very little less than a right angle, so that the projecting arm, whose length should be adapted to the width of the mounting table, say 4 or 5 inches, may be slightly depressed below the horizontal plane; it terminates in a pointed nozzle, bent downwards, and somewhat thickened, to prevent fracture. The tube shown in the left of the figure merely passes through the stopper at one end, and at the other into a small rubber bulb, such as is sold by every druggist. The interior of this bulb must be freed from any loose sulphur or dust, by thorough rubbing and squeezing, before it is attached to the tube. The safety-tube, on the right, merely passes through the stopper, and at its outer end is supplied by a short piece of soft rubber tubing, which rests against the side of the bottle. The vessel should not be filled h balsam to more than two-thirds of its height, and both during the filling, and all subsequent handling, care must be taken to avoid smearing, either the interior of the neck of the bottle or the stopper, with balsam. On account of the viscidity of the balsam while cold, it is best to heat the vessel before mounting, until the balsam becomes sufficiently fluid; this can be most readily effected by standing a few minutes on one end of the heated mounting table, or still more conveniently on an adjacent steam register, air bath, or stove. In mounting, the bottle is grasped and held by the left hand, between the four fingers on the one side, pressing and closing the end of the rubber tube, and the ball of the thumb on the other, while the end of the thumb is used to press the rubber bulb, and so force the balsam up and out of the delivery tube, in any desired quantity—under perfect control. Or, both hands may be used, or the position of the bulb and rubber tube may be reversed, by swinging round the delivery tube, and handled in that way, according to taste. By the release of pressure and re-opening of the safety-tube, on the removal of the hand, the balsam in the delivery tube regurgitates into the bottle. It is also best to keep the nozzle of the delivery tube covered, when out of use, with a little loose leather cap, to prevent the attachment of flying fibres and dust. In the course of extensive use, the turpentine vapors evolved by the heated balsam attack the rubber bulb, with a separation of sulphur, the ejection of which, however, is prevented by the position of the bulb. The rubber stopper, if employed, is also softened; but ordinary careful handling, and the replacement of the injured parts, easily prevent the introduction of impurity into the mounting medium. Any extreme carelessness, however, as by inclining the bottle sufficiently to bring the balsam in contact with the stopper, or into the tubes, may render it necessary to cleanse the whole apparatus, and replenish with fresh balsam. The original bottle in which the balsam is procured from the dealers, may be used for the purpose, only requiring to be fitted up with a stopper and tubes, as above described. The same apparatus may obviously be employed for other mounting mediums, especially for those which are fluid without the application of heat, or for solutions used in injection, or for ordinary use, as a wash bottle in the laboratory. It is found in practice, especially when the bottle and delivery tube are kept warm, that the jet does not become clogged, and that the balsam is delivered free from bubbles. When a more volatile liquid is kept in the bottle, the safety tube may be plugged with a piece of glass rod, when out of use. The rubber bulb might be replaced, as in Dr. Beale's apparatus, by an upright thistle, or funnel tube, with its mouth covered by an elastic drum of sheet rubber; but this does not act as well in practice, and there is a gradual loss of elasticity in the thin membrane.

The apparatus is open to evident objections, but a satisfactory trial of it for over two years, during which it has attained its present form, gives it a decided preference, in my view, over any other plan, particularly for continuous work. In acknowledgment of the original and principal suggestions, I propose for the apparatus the name of "Bolton's Mounting Bottle."

ALEXIS A. JULIEN.

A New and Cheap Form of Heliostat.

Read by L. M. Willis, M. D., before the Dunkirk Microscopical Society, Dec. 14, 1877.

A HELIOSTAT is desirable whenever it is wished to keep the image of the sun fixed for some time upon any selected spot, as in micrometry, or the measuring of the size of microscopic objects, or still more so in delineating them from a picture thrown down by a camera lucida in a dark room, which will remain for a long time unmoved from its original position, so that the pencil of the delineator has merely to follow the lines; but it becomes absolutely indispensable in micro-photography, where the slightest movement upon the plate of the beam of light would be fatal to the success of the photograph.

Many forms of heliostat have been devised, most of them too complicated and expensive for everyday use. The one shown in the accompanying illustration is constructed from any ordinary so-called marine clock, in which the hour movement is altered, by the addition of extra wheels, so as to make but *one* revolution in twenty-four hours.

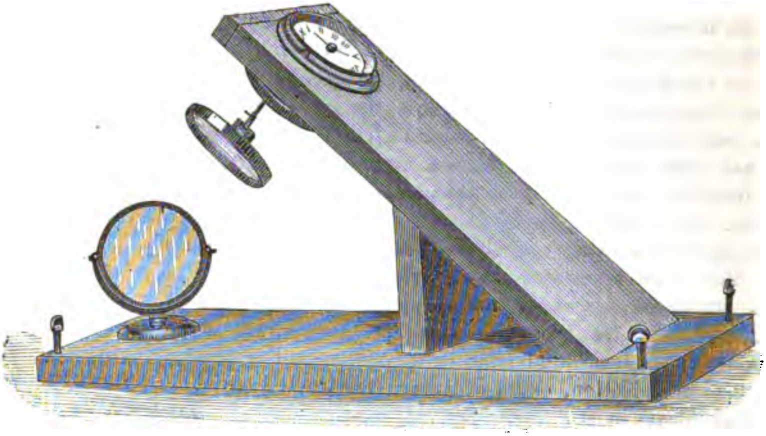
The number of wheels to be added will depend somewhat upon whether the mirror is to be suspended *below* the inclined support, as in the illustration, or is to be placed *above* it, as is sometimes desirable. If the clock face is below (and the mirror above) the movement of the hands would, of course, be in opposition to that of the sun, and an *odd* number of wheels will be needed to correct this. If the face is on the upper side (and the mirror below), an *even* number of additional wheels will be requisite. This part of the work I have thought best to entrust to a watchmaker (to be made after my plans), as it requires a considerable degree of skill to make the wheels properly.

To make the instrument efficient, it is necessary for the spindle, or arbor, carrying the movable mirror, to be in a direction exactly parallel to the axis of the earth; therefore the inclined support must be fixed at an angle with the leveled base equal to the complement of the latitude of the place where the instrument is to be used. This complement is, of course, found by simply subtracting the latitude from 90°.

The instrument is then to be adjusted due north and south. The simplest way of doing this is to ascertain exactly when the sun is on the meridian of the place, or, in other words, when it is noon, by adding or subtracting the number of minutes that the sun is fast or slow of the clock, from the time indicated by a good watch, (most almanacs have a column giving the sun's time, as fast or slow, for every day in the year), then adjusting the instrument exactly parallel to the shadows cast by the sun at that moment.*

The reflected ray (from the moving mirror) must fall upon another mirror, which must be exactly in line with the spindle of the moving mirror on the clock, so that when the instrument is properly constructed, all that is to be done is to place the moving mirror on the spindle, that the ray is reflected squarely upon the second mirror, which in its turn can then be set so as to direct the ray to any desired spot, where the movements of the first mirror, corresponding with the apparent motion of the sun, will keep it fixed for any reasonable time.

The most desirable exposure for using the heliostat is one where the window faces about southwest, which will enable us to use the sunlight from about 10:30 A. M. till sunset.



WILLIS' HELIOSTAT.

The instrument as described can be constructed at an expense of from $25 to $30, or perhaps even less, and is quite as useful for most purposes as the more complicated and costly patterns.

* * *

Another Postal Absurdity.—Just as we go to press, we learn that the legal advisers of the P. O. Department at Washington have decided that diatomaceous deposits are not mailable! The decision is authoritative, and for the present puts an end to our distribution of material, except at letter rates.

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*In most railroad towns the standard time kept by watches and clocks is not the mean time for that place, but for the headquarters of the principal railroad, which is kept by all employes, and telegraphed over the road every noon. In Dunkirk the standard time is that of New York city, which is 20 minutes faster than Dunkirk time proper. Therefore 20 minutes must be subtracted from clock time before making the correction mentioned above for sun time. (G. E. Blackham.)

Are Diatoms Destroyed by Drying?

A paper addressed to the French Botanical Society, November 25, 1877, by M. Paul Petit.

WHEN summer heats have dried up the ditches, the pools and the ponds, the diatoms which have swarmed in them are gone. Yet hardly have the autumn rains filled anew these reservoirs, when life again appears, and the diatoms are found in abundance after the first few days.

To what cause shall we attribute the reappearance, almost sudden, of these little organisms? I propose to describe, in a brief way, the result of some experiments I have tried for the purpose of clearing up this point in the life history of diatoms.

For several years I diligently gathered the surface earth in dry ditches where I knew great quantities of diatoms had lived, hoping to find spores or zygospores, as we do in the case of desmids. But the most I got for my pains, were frustules, emptied of the endochrome, scattered through the earth on which they had grown.

Having never found even a trace of spores, it came into my head, that to make a satisfactory examination, I should renew, as well as I could, the conditions of nature. So I collected, at different times in the year, diatoms with their substratum of soil or of clay, and left them to dry naturally, in the sun, some for six, others for eight months, and all in glass vessels protected from dust.

The drying was so thorough that the mass at the bottom of each cup was cracked and fissured in every direction. Last September, I examined portions of the dried mass. I saw that the frustules of the diatoms were, as I have already said, transparent and therefore apparently empty. But on closer examination I saw that, in many of them, there were at one end, a few large brown grains, which I thought were the remains of the dried endochrome. Then I filled the cups with distilled water, first filtered and then aerated by prolonged shaking, and left them exposed to the direct light and heat of the sun.

For two or three days no noteworthy alteration appeared in the frustules, but after the fourth day the large brown grains had swelled and taken on again the peculiar yellow tint of the endochrome of diatoms.

As I followed from day to day the increase in volume of the protoplasm, I found that at the end of five days it filled nearly half the frustule. The eighth day it had assumed the normal and characteristic form for each kind. The *Naviculæ* had resumed their curious movements, and some days later, I was able to detect proof that some of the frustules had begun to multiply by division.

These observations warrant the conclusion that diatoms, like many of the lower orders of beings, preserve their vegetative power in spite of desiccation.

At the same time I noted another fact which deserves mention. In one of the cups, diatoms were found attached to the sides in large numbers; but these never got again the normal condition of the endochrome.

In these cases, probably, the protoplasm was killed by too rapid drying. Since those that were on the surface of the mud or clay were only slowly dried, as, little by little, their substratum parted with its moisture, the plasma could therefore contract slowly, preserving the ability to return to life under favorable conditions.

To preserve their vegetative power, then, it is necessary that the diatoms should dry gradually, which, in fact, is just what occurs in the ditches and pools.

These observations make it easy to understand how it happens that when the wet season begins, we see diatoms start up, almost instantly, in places where we might vainly search for them during a drought.—*Translated from Journal de Micrographie, Paris.*

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—Books taken from circulating libraries and used by convalescents, may become the means of spreading contagious diseases. Persons who have suffered from such diseases should be prohibited from taking books from public libraries.

Amœba Proteus.

BY PROF. JOSEPH LEIDY.

A WONDERFUL creature is the *Amœba*, one of the lowliest of the lowest class of animals, a mere speck of the thinnest jelly, endowed with the usual attributes of all living things. Possessing an extensile and contractile power, it puts forth portions of its material in any direction; which portions act as temporary instruments of locomotion and prehension, and which again withdrawn, melt away in the common mass without leaving a trace of their previous existence.

The human body, with its intricate mechanism and appliances, is a theme of incessant wonder and admiration, but the *Amœba*, in its simplicity of structure and capabilities, may reasonably excite the same feelings. Though it has long been known, it has recently acquired new interest, from the discovery in higher animals of jelly-specks, which in structure and endowments are undistinguishable from the free *Amœba* of stagnant waters. The white corpuscles of the blood travel through the tissues of our body as independent beings, just as the *Amœba* creeps in the mud of a pool, and so alike are they that the wandering corpuscles appear as if they were parasitic *Amœbæ*.

With such a creature as an *Amœba*, of the utmost simplicity, a globule when quiet; of the most variable and ever-changing shape when moving, one would not anticipate the recognition of different kinds, of the character of the more fixed specific forms of higher animals. Nevertheless, we observe, *Amœbæ* varying greatly in size, in the general habitual shape they assume in motion, in the extent and usual form of the locomotive prolongations, and in some other points, ordinarily sufficient to render different kinds distinguishable from one another.

Many naturalists think that all varieties of *Amœbæ* are transitory phases of one and the same species, and this view is in some measure confirmed by the occurrence of intermediate or transitionary forms, which make it impossible, in many cases, strictly to define the limits of more characteristic and striking forms, such as we commonly find. The same reasoning, however, applies with more or less force to higher organic forms, and as with these, it is at least convenient to refer to the different kinds of *Amœbæ* as so many named species.

The first notice we have of the discovery of an *Amœba*, is by Rösel, in a work entitled "Insecten Belustigung," or Recreation among Insects, published in Nurnberg in 1755. Rösel calls the animal the little *Proteus*, and accompanies his description with colored figures engraved by himself.

Linnæus, in the Systema Naturæ, referring to Rösel's animal, named it *Volvox Chaos*, and afterwards *Chaos Protheus*. Nearly at the same time Pallas called it *Volvox Proteus*. Müller subsequently gave it the name of *Volvox Sphaerula*, but later, after having himself observed the animal, described and figured it under the name *Proteus diffluens*.

As the generic name of *Proteus* had been previously appropriated for the well-known salamandroid of Adelsberg, Bory de St. Vincent substituted that of *Amiba* for the animal of Rösel and Müller, calling it by the various names of *Amiba divergens*, *A. Roseli* and *A. Mulleri*.

In 1830, Ehrenberg described a comparatively small *Amœba*, which together with all others previously noticed by different authors, he referred to the same species under the name of *Amœba diffluens*. In 1831, in the Transactions of the Academy of Sciences of Berlin, p. 79, Ehrenberg described what he considered to be a new species of *Amœba* with the name of *A. princeps*. Its characters are as follows: "Diameter 1-6th of a line; body transparent, yellowish, with many readily and voluntarily movable blunt processes, four times larger than the *Proteus*." In 1838, in his great work, the Infusionsthierchen, Ehrenberg described *Amœba princeps* as "large, yellowish, equaling 1-6th of a line, provided with a variable number of cylindrical appendages, thick and rounded at the end."

Accompanying the former description there is also one of *Amœba diffluens*, as follows: "Diameter 1-24th of a line, body clear as water, with mostly three or four variable processes; four times less than the former species." In the Infusionthierchen the same is described as "branching, rarely extending or exceeding 1-24th of a line, colorless, with processes variable, moderately long, robust, and subacute."

From the descriptions it appears to me that Rösel's little *Proteus* accords with Ehrenberg's *Amœba princeps*, and not with *Amœba diffluens*. Ehrenberg says *A. princeps* is four times larger than the *Proteus*, meaning *A. diffluens*, and not the *Proteus* of Rösel, for this as represented by Rösel is of greater size than that given by Ehrenberg to *A. princeps*. It would naturally be supposed that an *Amœba* discovered by the earliest observers, with instruments less perfect than those later in use, would be one of the larger and more common forms. That such was the case appears fairly proved by both figures and descriptions.

Rösel, referring to a figure of his little *Proteus*, remarks that in its natural size it looks like Fig. A. Now this represents the animal in its quiescent state in globular form, and the figure measures four-fifths of a line. No *Amœba* has since been recorded so large as this, and we may look upon the figure as somewhat exaggerated, which might readily have occurred without the accurate measuring instruments which came later into application to microscopic objects. Rösel also refers to his having held the *Proteus* at rest with the point of a feather, so that the evidence is sufficient to prove that the *Amœba* was one of the largest kind. Taking size alone into consideration, Rösel's *Proteus* is as far removed in one direction from Ehrenberg's *Amœba princeps*, as *Amœba diffluens* is in the opposite direction. But in other characters Rösel's *Proteus* agrees with the former closely,, and not with the latter.

Ehrenberg describes *A. princeps* as yellowish, the *A. diffluens* as colorless. Rösel says nothing of the color of the *Proteus*, but his figures are colored yellowish. Most of Rösel's figures exhibit the characteristic changes of form of the animal in movement, and of one of these he remarks that in its branching it resembles the antlers of the deer.

As regards the concurrence of size and color of Rösel's *Proteus*, it might apply to other large *Amœbæ*, instead of *A. princeps*, as for instance the *A. villosa* of Wallich, or the *Pelomyxa palustris* of Greef, but the changes of form represented as occurring in the *Proteus* of Rösel, approach it rather to the former than to either of the latter.

Müller's descriptions and figures of *Proteus diffluens*, which that author regarded the same as Rösel's *Proteus*, likewise appear to apply to the same animal named *A. princeps* by Ehrenberg, rather than to that which he named *A. diffluens*.

If the views taken, as above expressed, are correct, it must be admitted that the *Amœba princeps* of Ehrenberg is the same animal as the *Proteus diffluens* of Müller and the little *Proteus* of Rösel. Even consenting to the opinion that all forms of *Amœbæ* may eventually be shown to be transitory phases of the same species, it does not render the determinations of Ehrenberg and his followers, in regard to *A. princeps* and *A. diffluens*, any the less incorrect.

Arriving at the conclusion that the common large *Amœba*, usually assigned to *A. princeps* is the same as the *Proteus* of Rösel, the question arises as to its appropriate name. Of the specific names employed for the little *Proteus*, that of "*Chaos*" is the oldest, but appears to me less appropriate than that of "*Proteus*," applied afterwards. As the latter cannot be used in its generic sense, it might be accepted in its specific application so as to perpetuate the name given to the animal by Rösel, its discoverer. While, therefore, in strict conformity with the rules of zoological nomenclature the little *Proteus* of Rösel, the *Proteus diffluens* of Müller, and the *Amœba princeps* of Ehrenberg, would be called *Amœba chaos*, I would suggest that it should be called *Amœba proteus*.—*American Naturalist.*

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The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the American Journal of Microscopy. This certainly demonstrates the value of the journal as an advertising medium."

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Notice to Subscribers.

THE present number of the Journal will be sent to all old subscribers except those who have positively ordered a discontinuance. We hope that those who intend to subscribe for next year will remit as soon as possible. Those who order through our agents are, however, requested to make payment to them. It is fair to assume that those who do not remit before the issue of the next number do not want the Journal.

Cutting the Journal.

WE announced last month that we had found an invention which enabled us to send the journal out untrimmed and and yet with the leaves cut. Unfortunately the arrangements were not quite perfected and part of the edition was sent out trimmed and part uncut. We hope that in the future we will not have another dispointment of the kind.

The Postal Laws.

WE are glad to learn that the microscopical societies throughout the country are making most earnest and vigorous efforts to have the present law so amended that it may conform to the dictates of common sense. That the *entire* postal law needs careful revision in the interest of the business community, requires no argument. No one of these interests conflicts with any other, and if a unanimous effort had been made to pass a common sense law, it could have been done without any trouble. But the selfish proceedings of the Boston publishers has made the passage of any amendment difficult. At present it looks as if justice would be done to the scientific men of the country, and the present restrictions would be removed, while it is very certain that the publishers have failed to obtain some of the points for which they were very anxious, and which a more general support would no doubt have pushed through.

Exchanges.

WE have been asked to publish our rules in regard to exchanges—the time they are kept in, etc.

The general rules we publish at the head of the exchange columns. As we charge nothing for inserting exchanges, the time that they are kept in must depend upon our own convenience as to space, etc. Sometimes they are kept in for a long, sometimes for a short period. Our desire is to do everything we can for the convenience of our subscribers, but whenever we find occasion to omit the exchange list or any part thereof, we receive the right to do so.

Of course those who wish to bring any particular subject before our readers with certainty and regularity, can avail themselves of our advertising columns; and notwithstanding our large circulation, we have placed the rates for such advertising so low that they are within the reach of all. Some who are not subscribers but who have seen the journal in libraries, or in the hands of friends, have sent in exchanges. To such we would say that the privileges of our exchange column are open only to those who are regularly entered on our books as subscribers. The amount of advertising that we *give* to our exchangers would cost them many times the subscription to the journal if they obtained it at usual rates. It is not, therefore, asking too much to request would-be exchangers to support the journal by their subscriptions.

Our Book Table.

Biology. By Dr. Charles Letourneau. Translated by William Maccall. With 83 illustrations. Philadelphia: J. B. Lippincott & Co.

The author defines "Biology" as the exposition and the co-ordination of all the great facts and great laws of life, or nearly what is usually understood by "General Physiology," when this denomination is applied to the two organic kingdoms. In this volume an attempt is made to state concisely what life is, and how organized beings are nourished, grow, are reproduced, move, feel and think. Nearly five hundred closely printed pages are devoted to this task, and with remarkable success. The work is clearly written in a pleasant style, and is illustrated by figures which, if not of the most artistic kind, are at least characteristic. The volume is one which may be safely recommended to the general reader as giving an excellent resumé of the present state of the science.

Is Modern Education Exerting an Evil Influence upon the Eyesight of our Children? By A. W. Calhoun, M. D. Reprint from the Atlanta "Medical and Surgical Journal."

The author believes that our modern school books are *ruining* the eyes of our children, and suggests several ways in which they may be improved. His little brochure deserves attention.

Correspondence.

The Editor of the American Journal of Microscopy does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Collar Adjustment.

Ed. Am. Jour. Microscopy—On page 32, of the February number, I found the following: "It is stated that Mr. Tolles makes objectives in which the collar adjustment produces no change of focus. We are not aware that Mr. Tolles himself has ever made such a claim. If he has it would be interesting to know how this is accomplished. It seems there must be some misunderstanding about the matter on the part of certain ones who speak with authority."

I had never heard this statement in reference to Tolles' objectives, and it seemed so absurd on the face of it that I felt confident that Mr. Tolles himself had never made such a claim; but I wrote and asked him the direct question, and received promptly the expected response, "No, sir; I didn't do or say any such thing." Mr. Tolles did originate the plan of making correction for increasing thickness of cover, by approximation of the posterior combinations to the front, without moving the front or rotating any of the combinations on their axes. This I heard long ago, but the statement I have quoted I never did hear (in reference to Tolles' or any other American lenses), and would be obliged to Prof. Hitchcock if he will state, when, where and by whom it was made, and also say who are the "certain ones who speak with authority."

Further, I have never heard or read of *any* objectives "in which the collar adjustment produces no change of focus," except in a work which, to judge from previous articles, Prof. Hitchcock appears to regard as good authority on the optics of the microscope, viz., Frey's "Microscope and Microscopical Technology," Cutter's translation, 1872. In a foot note to page 60 of that volume, I find the following interesting information, viz.: "With Hartnack's arrangement, after each correction of the objective, the focus is naturally to be re-adjusted; *this is not the case, however, with those of the English opticians, in which the position of the lowermost lens remains unaltered during the correction.*"

The words which I have italicized seem to be the result of a misunderstanding about the matter, so great as to be accounted for only by the supposition that the writer had never examined the English objectives of which he was writing, and had also entirely failed to appreciate the nature of the optical problems involved in the correction for cover, by varying the distance between the combinations of the objective. Only upon this supposition can I account for his curious conclusion that because the position of the lowermost lens remains unaltered during the correction, therefore the focus would not have to be re-adjusted after each correction of the objective.

Of course, we expect to find these little points in the writings of that school which seems to regard the microscope as a mere tool for the biologist, and to resent any time spent upon it for its own sake as an unwarrantable diversion from the "legitimate natural history applications of the instrument;" and this foot note is so much of a piece with the general tone of the optical portion of Frey's work, that I should not have thought it worthy of special mention, but for the suspicion that Prof. Frey must be one of the "certain ones who speak with authority," in spite of the fact that there is on their part "some misunderstanding about the matter." GEO. E. BLACKHAM.

Dunkirk, N. Y., Feb. 18, 1878.

The Scale and Vernier Improvement in Stands.

Ed. Am. Jour. Microscopy—I fear your readers will tire of the discussion as to whether I "adopted" the scale and vernier device from Mr. Fell, or devised it independently for myself. Nevertheless I ask space to reply to the letters from Prof. Smith and Mr. Fell, in your March number. As both letters cover substantially the same ground, I will confine myself mainly to that of Mr. Fell, which comes first in order.

It is quite true that in my specifications for a new stand, which were sent to Mr. Tolles, April 11, 1877, no mention was made of the scale and vernier device, the addition of which was but one of several modifications introduced while the stand was in process of construction, to make it more completely serve "the object held steadily in view in designing and constructing it." The first specifications were only provisional, and in the letter accompanying them I requested Mr. Tolles to suggest amendments, which he did from time to time, to my great benefit.

It is also quite true that I had the pleasure of a visit from Mr. Fell, who spent an evening (and night) at my house in the latter part of October, 1877. Before his arrival I had already decided to have the scale and vernier attached to my new stand, and in the course of the evening mentioned this fact to Mr. Fell, who commended the idea, and said "he had often thought of it himself." The next morning I wrote to Mr. Tolles, describing the device, claiming it as mine, and requesting him to have it applied to the stand. Mr. Fell read this letter, at my request, and made no objection to my claim at that time, as indeed he had no reason to do. It was with considerable surprise that I learned afterwards that he claimed to have suggested the device to me.

He now states, and Prof. Smith endorses the statement, that he had suggested the device to Prof. Smith and others as long ago as April, 1876.

It seems strange that in all this time he had never utilized it by applying a scale and vernier to his own stand; that he had never made it public; that Prof. Smith should have known of it for eighteen months or more without utilizing it, and suddenly come to the conclusion to do so after I had done so; and that if it was suggested to Prof. Smith in April, 1876, he should wait till I had devised and applied it, and then, in November, 1877, write of it that Mr. Fell "has *recently* suggested" it.

It is also strange that although I enjoyed the pleasure of a tolerably intimate acquaintance with Mr. Fell all this time, and our discourse was frequently of matters microscopical, I should never have heard a word from him about this device till that evening in October, 1877, and then not till I had first mentioned the matter to him."

I by no means wish to deny that my friend Fell thought of this device before I did, or even that he suggested it to others, but I do say most positively that at the time I devised it I knew nothing of his thoughts or suggestions on the subject; that I was not aware that he or any one else have ever used or thought of it; and that I never heard him speak of it till after I had told him that I had decided to make use of it myself.

The device is a simple one, and *may* have been used by others before I ever saw a microscope, though I did not then, and do not now know of such a case; but, having devised it for myself, without knowledge of any previous efforts in that line on the part of others, it seems to me that I had a perfect right to claim that I did so, and to deny that I "adopted" it from Mr. Fell or any one else.

I have had no desire, in this correspondence, to make any attack upon Mr. Fell, with whom I have spent many a pleasant evening over the tube, nor upon Prof. Smith, who first taught me the value of Tolles' lenses, and for whose remarkable manipulative skill I have a sincere admiration, albeit my personal relations with him have been anything but cordial for more than a year; but I have aimed simply to defend myself from the charge of plagiarism. Having done so, by stating the facts as clearly and as courteously as possible, I rest my case, leaving to Mr. Fell, or any one else who may choose to claim it, whatever honor there may be in having thought of or suggested the application of a scale and vernier to the microscope as long as they like before I devised and utilized it.

GEO. E. BLACKHAM.

Dunkirk, N. Y., March 30, 1878.

Volvox Globator.

Ed. Am. Jour. Microscopy—I find that while a few microscopists in this country are familiar with the *Volvox*, the majority have never seen them, and only know of them from the books.

Now, judging from the interest evinced in this beautiful and marvelous plant when it has been shown to microscopists, I thought it would be of importance to those about New York city, to know where it may be found in their vicinity. Probably the nearest known locality is just north of the town of Union Hill, N. J., (about opposite Fortieth street, New York,) in some of the quarry pools. I have also found them just north of Guttenberg, N. J., and once I found a few on the Hoboken salt marshes, in a fresh water hole there. Prof. Phin finds them near Paterson, and under the guidance of Mr. A. D. Balen, I have taken them near Plainfield, in this State. I have had them from Bethlehem, Pa., also.

In this portion of this country they have been found at all seasons, although scarce in winter (when none are seen in Great Britain.) I had the pleasure of distributing a few at the meeting of the New York Microscopical Society, on the evening of January 18th, which I had collected that day from under ice 4¼ inches thick. They are most plentiful from June to September. Will not others throughout the Union inform us through your valuable journal, where they find these, and other interesting "micro-organisms" from time to time.

CHAS. S. SHULTZ.

Hoboken, N. J., Jan. 21, 1878.

Angular Aperture.

Ed. Am. Jour. Microscopy—Your readers should all feel greatly indebted to you for the admirable address of Prof. J. Edwards Smith, delivered before the Dunkirk Society. I am pleased to acknowledge that this address has been of no little benefit to me, in showing just what ground my gentlemanly opponent holds, as well as in other ways. The address is very different from what I inferred from the garbled reports which have reached me.

Whatever the merits of the question may be, I am contented to leave the discussion where it is for the present. We have each ventilated our opinions pretty thoroughly, and I am pleased to acknowledge that he has more on his side than was evident at first, and also the ability with which he has handled his subject.

Nevertheless, I have a point to criticise, not as a microscopist merely, but as one who demands accuracy of expression in every branch of science.

In microscopy, if we would have it a science, we must exclude anything that is capable of misinterpretation in our language. I protest, then, most strongly, against the use of such terms as 180° or plus 180° of aperture. When I say that an aperture of plus 180° is a perfect impossibility, I only speak a truth which every intelligent man acknowledges at once. Argument cannot be brought to bear against it, for absurdity is on the face of it. If an optician chooses to mark a lens 180°, or plus 180°, there is no law to prevent it. He can as well add another 45° to it if it pleases him. But it is quite another thing when we come to the scientific student. Prof. Smith has already criticised me for asking the why about certain things, but I maintain it to be the right, and duty even, of every man of science, to ask this little question whenever it occurs to him. So, when he finds a lens marked 180°, he is right in asking why is it so? When he simmers the matter down, the answer most pertinent appears to be—because it is not 180°. Is this reason right or wrong? It seems very silly, but I will venture to say that if the question were put to a thorough physicist, not familiar with the literature of the microscope, and knowing nothing about balsam or fluid mounts, he could never get a clue to its meaning. If an optician chooses to indulge in these absurdities, must the scientist be led by the nose and adopt them, and teach them, or at least use them before an audience without an apology? I think not.

In no other branch of science would such an erroneous term find use, and I protest against it here. The scientist has no right to say what he does not mean; and he has no right to presume that his hearers will understand him, if he uses incorrect language.

The meaning of 180° is 180°, and nothing else, and plus 180° does not mean 97° balsam, or any other balsam angle.

This subject is very imperfectly understood by the ordinary worker, and on this account, if for no other, the misleading angles should not be used. There is not the slightest justification for their use, for the true apertures can be measured and definitely stated. I object to such figures on behalf of true science.

ROMYN HITCHCOCK.

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TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of March 15, Mr. Hyatt, the President, in the chair.

After reading of minutes and some other business, the President presented to the society a black-board, and Mr. Scott gave a number of echinus spines.

The committee on postal laws reported that a memorial had been addressed to the Hon. J. D. Cox, of Ohio, and copies were sent to the various microscopical societies in the country, together with a letter asking for their co-operation in the matter. A letter from Dr. Blackham, President of the Dunkirk Society, was read in reply to these circulars.

The following active members were elected: W. L. Leaman, C. L. Van Brunt, F. W. Gwyer, and Dr. Frank Deems. Prof. H. L. Smith was made an honorary member.

The Secretary described a case for collecting microscopic objects. A paper by the President was announced for the next meeting. Subject: "Stings of Hymenopterous Insects."

Among the objects exhibited, Mr. Scott had a beautifully arranged type slide of sixty foraminifera, and another fine slide of foraminifera from Florida, each form being placed so as to show to best advantage.

Prof. Phin exhibited a Zentmayer pocket microscope which was the admiration of all. This is without doubt the most compact and perfect pocket instrument made, but its cost is $40.00. Several ladies were present at the meeting.

R. HITCHCOCK, Recording Secretary.

A regular meeting of the New York Microscopical Society was held on the evening of April 5, the President, Mr. J. D. Hyatt, in the chair.

After the reading of the minutes, the Committee on Admissions reported on the names proposed at last meeting. The Curator reported the following donations:

From Messrs. J. L. Wall and R. Hitchcock, two specimens of diatomaceous deposit, collected by the late Prof. Bailey, in a bog below Fort Putnam, West Point. These specimens are from Prof. Bailey's original collections, and are on this account highly valued by the Society. As it is now almost, if not quite, impossible to reach this deposit, owing to the wet nature of the soil beneath which it lies, these samples afford ample proof of its existence.

From W. H. Leaman—Fungi, Didymium cinereum and Arcyria punicea; diatomaceous earth from Richmond, Va.; diatoms from Farmingham, Mass.; seeds of Pinckneya pubescus; portion of root of Sponica pandurato.

From R. Hitchcock—Diatomaceous deposits from Monterey, Santa Barbara and San Gregorio, Cal.; and Virginia, Nev.

From Eugene Mauler, Switzerland—Diatoms from Island of Für, Jutland.

From T. H. Engels, Diatoms from Virginia, Nev.; four slides of wood sections.

From G. L Whitehead—One slide, gizzard of cricket.

From Dr. Carl Seiler—Six fine injections of kidney and stomach of cat.

The Secretary read a letter from Hon. J. D. Cox, who has taken active steps to secure such modifications of the postal laws as will benefit microscopists and scientific men, from which it appears probable that the efforts made by this Society and others have not proved in vain. Other communications from various societies regarding this matter had been received by the committee, indicating no lack of interest throughout the country.

Dr. L. Schoeney was elected an active member, and Capt. John H. Mortimer an honorary member.

The President, Mr. J. D. Hyatt, gave an account of his observations on the stinging organs of bees. The process of stinging had, in his opinion, never been satisfactorily explained. His studies on this subject have covered a period of the past eight years, and only recently has he been able to understand the operation of introducing the poison into the wound during the act of stinging. This paper will soon be published in full.

Several visitors were present, and the meeting was one of considerable interest.

R. Hitchcock, Recording Secretary.

Microscopical Section, Troy Scientific Association.—A regular meeting of this section was held on the evening of April 1st, Dr. R. H. Ward, chairman of the section, in the chair.

Minutes of the last regular meeting and record of the subsequent *soiree* was read and approved.

Dr. Ward announced an invitation from the microscopists of Indianapolis to their fellow-workers throughout the country, to attend a National Congress of Microscopists in that city, commencing on Wednesday the 14th of August next, and adjourning in time for members to attend the meeting of the American Association at St. Louis, one week later. The biological section of the Indianapolis Lyceum of Natural History, assisted by many influential citizens, will make ample arrangements for the comfort and economy of visitors from abroad, both in obtaining reduced rates of travel and in the most liberal entertainment while in the city. A detailed statement of the proposed work of the Congress and of the facilities offered by the local management will be given to the public, within a few weeks, in the form of a circular. The committee of arrangements, consisting of Prof. E. T. Cox, chairman, Mr. E. Sharpe, Dr. Henry Jameson and Dr. W. W. Butterfield, secretary, have received the individual endorsement and promise of co-operation of leading microscopists, and now formally extend an invitation to the microscopical societies and workers throughout the country, with the assurance of a successful meeting. Such a congress, with its opportunities for stimulating microscopical work, discussing questions of general importance, and cultivating personal acquaintance among fellow-workers in the science, has been under consideration for some time, and the present year is believed to be an unusually favorable opportunity for the meeting, on account of the facility with which scientists from the Eastern and Southern sections can visit Indianapolis on their way to St. Louis, with no additional expense and no delay save the time spent at the congress. Microscopists desiring to attend should apply to the secretary of the committee for circulars giving further information, and should send notice of any important business to be offered for consideration, and titles of papers proposed to be read, accompanied by a copy of the papers, or by abstracts of the same, to the Secretary of the committee at least two weeks before the time of the meeting, in order that a correct programme may be prepared.

The invitation to the Congress at Indianapolis was, on motion, accepted, and it was resolved that members finding themselves able to attend should give early notice to that effect to the Secretary of the committee, at No. 413 N. East street, Indianapolis.

Mr. Joseph McKay gave a demonstration of Prof. H. L. Smith's method of dry mounting by means of a background of wax and a curtain-ring cell, showing the facility and elegance with which this method may be carried out.

Rev. A. B. Hervey described a new method of fluid mounting, which he had recently devised. In his study of the algæ and lichens he had been troubled, as others had been, by the difficulty of permanently mounting specimens while studying them, without waste of time or change of arrangements. Most of the methods of mounting either ruin such objects entirely, or else require considerable time, care, and special appliances that are troublesome to a busy student; and therefore instructive specimens are often neglected and lost. The objects may be transferred from water to Farrant's solution of gum and glycerine, and mounted without delay, but the structure is not well preserved, and air-bubbles are likely to be obstinately present. The objects show best in distilled water, sea water, camphor water, etc.; and to mount them instantly, and with uniform success, he prepares cells of the gum and glycerine solution, put on by means of the turn-table in the usual way. Having made cells of the required depth, and laid them aside until thoroughly dry, the inner half of the width of the cell is varnished on the turn-table with gold size, which is also allowed time to dry perfectly. Objects in water are arranged and covered in these cells with ease, and are ready after lying aside for a time, varying from a few minutes to a few hours, to receive a coat of gold size or other varnish, the fluid that exudes from the cell in pressing down the cover-glass having dissolved enough of the gum cell to hold the cover in position. It has not been found that the cell is too much affected by the fluid; but if it should be so the cell could be made of the usual cements, insoluble in water, and then coated with a thin layer of gum.

Mr. O. E. Hanaman demonstrated the use of the Nachet camera lucida, and quoted opinions from discussions at the Quekett Club to confirm its superior facility of use, as compared with the other forms of camera.

Dr. Ward presented the new self-centering turn-table recently contrived by W. H. Bulloch, of Chicago, and remarked that this table seemed to combine all the really radical improvements that have been made in the turn-table up to the present time. The early tables were more or less satisfactory varieties of the original Shadbolt form, and were arranged to be whirled in a variety of ways; but the first fundamental improvement was the self-centering table of Dr. Matthews, which centered the slide for width only between jaws swinging on opposite posts, and held it in place by means of a sliding wedge. This method is greatly simplified without at all impairing its efficiency, by discarding the wedge and jaws, and centering by the posts alone, in the table contrived and now made by Mr. Zentmayer. Mr. Cox has undisputed priority in the expedient which now surpasses all others, and seems likely to continue to do so, of centering for both width and length, by grasping the diagonally opposite corners of the slide between jaws that move automatically towards or from the centre, after the manner of the different forms of American scroll chucks. In Mr. Cox's table, now well known, the jaws are moved by a horizontal screw, with right and left threads on the opposite ends, under the revolving plate. Mr. Kinne adopted independently, but published subsequently, the same principle, but moved the jaws by a lever instead of a screw. Mr. Bulloch's table is essentially a modification of the Cox table, but moves the jaws by a scroll screw on the surface of a revolving plate, precisely as is done in the scroll chucks of the machinists. The revolving table is made double, of two horizontal plates, the jaws sliding through the upper plate by means of a screw on the upper surface of the lower plate, thus securing a very steady as well as convenient and durable adjustment. In addition to this, the posts and clips are added after Mr. Zentmayer's method, by which the slide may be centered for width only, or under which it may be adjusted artificially by means of concentric rings, as in the early forms of tables. The workmanship is good, beyond comparison with anything of the kind, except the one last mentioned; and the instrument, at its moderate price, can be commended as a real luxury to any one who desires a more elaborate form than that. It is one of the little things that are a great comfort.

State Microscopical Society of Illinois.—A regular meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, March 22, President Henry W. Fuller in the chair.

As Mr. Atwood, the Secretary, was absent, owing to the death of his mother, Mr. Stuart was appointed Secretary pro tem.

A communication was presented from the New York Microscopical Society, calling attention to a bill now before a committee of Congress, excluding "glass in any form from the mails," and requesting the society not only to act with them in preventing passage of said bill, but in securing such modification of present ruling as will enable microscopists to send slides and objectives through the mails as fourth class matter. The President appointed a committee to act in the matter, Messrs. Thomas, Bulloch and Stuart.

Professor E. S. Bastin, of the University of Chicago, read a highly interesting and suggestive paper on "The Vegetable Cell," the aim of which was to show the leading facts of cell structure, to demonstrate the intimate relations that subsist between the vegetable and animal cell, and to show the bearings of the facts of cell structure on the doctrine of evolution.

The author compared the protoplasm of the vegetable with that of the animal cell, and showed that there was no essential difference between them. There was a point where the distinction between the animal and vegetable cell disappeared, and the two kingdoms are two branches which spring from a common trunk. Developement, either in the animal or vegetable might pursue either of two distinct lines, According to the first mode, the cell as an individual might develop till it reached a high degree of perfection as witnessed in desmids and diatoms among plants, and some of the infusoria among animals. While, according to the second plan, a great number of cells, sometimes millions, are aggregated together into a common organism, and development proceeds by a differentiation of cell functions. Numerous examples were educed to illustrate these two modes, and the various gradations in each. The writer was of the opinion that the doctrine of evolution was the only one that could harmonize all the facts of cell structure, and reduce the life of the globe to a consistent scheme. It had been ridiculed, but was fast making conquests, and the time was not far distant when it would be accepted in some form by all thinking men. Men to day, earnest, thoughtful men, were asking anew the old question, "What is life" and they were not asking it from their imaginations, or the oracles, or from the priest, but from nature.

At the conclusion of the paper the members and visitors spent an hour at the tables, where prominent among the stands was one of new design from R. & J. Beck. It combines many desirable points at so moderate a price as to deserve a more extended description than can be given here. An achromatic condenser, by the same firm, seemed to present some advantages. The usual diaphragm was absent, and in its stead a system of five lenses, two of which were spotted, for dark ground illumination, rotated in a cap above the usual back lense.

Mr. Summers exhibited slides of transverse sections of magnolia grandiflora, showing thickening of cell walls.

ERNEST B. STUART, Secretary pro tem.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, February 21st, President Hyde being in the chair. A goodly number of members, amongst them Honorary Members Edwards and Wythe, were present, to assist the newly-elected officers in initiating another year of microscopical research and record.

As additions to the library there were announced a number of interesting books, most of which came from the library of the well-known Thomas Fiddian; the list comprised Schäfer's "Histology and the Microscope," "Hill on the Microscope," 1752; Pritchard's "Infusoria," Cobbold's "Entozoa," Master's "Vegetable Teratology," Ralf's "British Desmidiæ," Robin's "Traite du Microscope," Huxley's "Introduction to the Classification of Animals," "Des Coleurs," by Chevreul; "Pratique du Microscope," by Mandi and Ehrenberg; "American Naturalist," AMERICAN JOURNAL OF MICROSCOPY, "Cincinnati Medical News," "Quarterly Journal of Microscopical Science," "Nature," "English Mechanic," and "Popular Science Monthly with Supplement."

President Hyde gave a cogent summary of the recent remarkable discoveries of Professors Böll, of Rome, and Kühne, of Heidelburg, in the anatomy and physiology of the eye. He said that the popular notion that the murderer's image is found photographed as it were on the retina of his victim's eye, may have some foundation in fact, viewed in the light of these recent dicoveries, especially those of Dr. Kühne. Histologists have always considered the rods and cones of the retina, which are taken to be the terminal organs of the optic nerve, to be in a natural condition when under examination. Prof. Böll found, however, that when the animal, say a frog, is killed rapidly and the retina viewed as quickly as possible, it has peculiarities never before observed, and throwing new light on the physiology of vision.

Since the experiments of Dr. Kühne are more elaborate and extensive than those of Prof. Böll, a sketch of them will be most instructive. Prof. Böll found that the newly removed retina had a rosy purple tint, which was difficult to examine, because exposure to light changed it in ten seconds to a satiny lustre, and then after fifteen minutes of transparency to a turbid opacity. Dr. Kühne discovered that if kept in the dark, or in sodium (yellow) light, the delicate "vision purple" of the removed retina could be retained as long as wished, thus making a series of very original and incisive experiments possible. It is proved that the retina contains a substance which, under the influence of light, undergoes a chemical change varying in intensity with the intensity and character of the luminous rays. In the living retina there is some process which restores to this substance its responsiveness to light as fast as it loses it by the action of light—a continual recharging with powder, as it were, of the retinal batteries, which the impact of light waves is continually firing whilst vision continues. But after death, or removal of the retina, the gunner—the faithful heart with its supply of nutrient blood—having ceased his work, the last charge is fired and the batteries stand emptied. So, the light waves remove the color from the isolated retina in a few moments, unless they be shut out by darkness, then the retina can be kept in its natural condition, purple colored, the batteries ready charged to signal to the brain by their discharge the impact of the first light wave. Having thus the power of keeping retinæ just as they leave the eye, by immersing them in darkness, or yellow light, very much as the photographer takes his negative from the camera, and preserves and finally fixes the image, working at it always by yellow gaslight, Kühne also preserved the images that were in the natural photographic plate, the retina, of the natural camera, the eye, and actually fixed these images—by soaking them in a solution of alum. Thus he would fix the head and one of the eye-balls of a living rabbit opposite a bright skylight, cover it with a black cloth for five minutes, then remove the cloth, exposing the eye a few minutes, immediately remove the eye, soak in alum, and, upon examining the retina, find a beautifully accurate image of the skylight, showing its separate parts, the boards, etc. Even the eye in a severed head gave these results. The images were generally of a rosy hue.

Now, while this proves that images of objects seen before death may be found on the retina after death, yet, since to make this possible, the eye and the object must be perfectly still for some minutes, and the light must be strong, it probably never has happened, and never will happpen that the image of the murderer is found in the eye of his victim, murder being a deed of darkness, and a deed tending to anything but immovableness in those enacting it.

Dr. Wythe promised a future paper about his two amplifiers. For the present he simply drew attention to an article on "The Amplifier," in the AMERICAN JOURNAL OF MICROSCOPY, February, 1878, by Dr. Gustavus Devron, of New Orleans. This critic, like the others, seemed to wholly overlook the fact that Dr. Wythe had invented two very efficient amplifiers, and in claiming that the second one is not new, forgets the first. Tolles' amplifier, an achromatic meniscus, is fine, but does not equal Dr. Wythe's double concave amplifier, which has enabled him, with a fourth and ordinarily oblique illumination, to resolve Surirella gemma into beads. Dr. Wythe repeated his opinion that improvements in objectives had reached their limits, and we must look in the future to changes in the eye-piece for greater power.

After accepting the resignation of Mr. J. A. Langstroth as Treasurer, and continuing for some time the lively discussion inaugurated by President Hyde's remarks, the meeting was adjourned.

The regular meeting of the San Francisco Microscopical Society was held Thursday evening, March 7th; President Hyde being in the chair, and, in addition to a good attendance of members, C. E. Slocum, M. D., of Ohio, and Wm. E. Davis, Esq., of San Francisco, were present as visitors. After the election of Dr. O. Hoff, of this city, to membership, and of Mr. J. P. Moore to the office of Treasurer, additions to the library and cabinet were announced, as follows: By subscription, "Nature," "American Naturalist," "Popular Science Monthly," "English Mechanic," and "Bulletin Bussey Institute, Vol. II Part 3;" by donation, from Clarence King, United States Geologist, volume 5 of the "United States Geological Exploration of the Fortieth Parallel;" "Botany" from Prof. W. G. Farlow, a paper; "List of Fungi found in the Vicinity of Boston." To the cabinet, the California State Geological Society donated a diatomaceous earth; Mr. Allen Y. Moore, of San Diego, sent a slide of Encyomena caespitosum, a beautiful diatom, remarkable in this slide for its freedom from other forms, and Dr. Mouser presented a mounted section of the œsophagus of the goose. This last under the microscope, showed with surprising clearness the innumerable minute, secreting glands, with their slender ducts opening upon the interior walls of the œsophagus. Dr. Mouser stated that the arrangement of the muscular layers forming the walls of the goose's œsophagus was exactly the reverse of that in man, the external layer being internal and vice versa.

Letters were read from Messrs. R. Hitchcock and Fred. Habirshaw, of New York, relative to exchanges of diatom earths, valuable earths from Jutland, Germany and Canada being offered in exchange.

The Secretary was directed to join with the State Geological Society in sending as full a series of earths as the united resources of the two societies would make possible.

Mr. J. P. Moore, after stating that he would have a number of papers for the next meeting, opened a discussion on the preservative powers of boron compounds, by saying that he had been studying the action of boracic acid on vegetable tissues. In 1873, a German had taken out a patent in England for the use of boracic acid in preserving fibrin, blood, and meat for several months, for protecting linen, etc., from mildew and mold, for embalming bodies, and to prevent contagion. A recent article in the "Compte Rendu" had excited Mr. Moore's interest in the effect of treating plant tissues with boracic acid, and one of the promised papers would treat of this subject.

The non-appearance of Mr. Moore at a recent meeting, through the effects of poison oak, led to some questioning of the efficiency of salicylic acid, his own much-trusted remedy; but he replied that the acid still thoroughly accomplished its work of expelling the poison, leaving, however, an inflammation which took some time to subside. A piece of the finely aromatic "yellow wood," which comes in logs down King's River, from some unknown place, and which is a very durable wood, lasting years, was, after microscopical examination, determined by Mr. Moore to be one of the Taxineæ, probably Torreya Californica.

EXCHANGES.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Slides of the sugar mite, amœba diffluens, and foraminifera, in exchange for good material, or well mounted slides of interest. Clark M. Elliott, Auburn, N. Y.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

British plants and bird's eggs for American ditto. J. A. Sanford, 289 Summit street, Toledo, Ohio.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, New York.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Material—Marine algæ from East and West Coasts, diatoms in situ on algæ, musci, lichens, ferns, lycopodia, etc., for mounted objects. M. A. Booth, Longmeadow, Mass.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merrim. n, Rochester, N. Y.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. III. NEW YORK, MAY, 1878. No. 5.

Isthmia Nervosa—A Study of Its Modes of Growth and Reproduction.

BY J. D. COX.

At the time Dr. Wallich's article upon the telescopic hoops of *Biddulphia*, *Isthmia*, and some other diatoms, appeared in the *Monthly Microscopical Journal*, of February of last year, it happened that I had in hand a considerable quantity of the *Isthmia nervosa*, *in situ* upon seaweed, from the vicinity of Santa Barbara, California. I at once determined to make a somewhat full examination of this material, and to learn what facts in the life history of this diatom could be drawn from the study of the dead specimens.

Part of the material I mounted dry *in situ*, so that it could be examined as either an opaque object or a transparent one; the rest was cleaned in acids, part mounted in balsam, and part kept in distilled water for examination in that condition.

The examination fully sustained Dr. Wallich's statement, that the hoop of *Isthmia* is often found to be of two or more concentric tubes, which slide over each other during the multiplication of the diatom by division; but in regard to the mode of growth of the hoop itself, the causes of variation in the size of the frustules, and especially as to the formation and function of the conjugate (or sporangial) frustule, the facts observed seem to point to conclusions so different from his as to warrant a detailed presentation.

At the risk of repeating some things too well known, I shall endeavor to give a connected description of the appearance of the diatom at the several stages of its growth, up to the appearance of the conjugate frustule, and through such subsequent steps as I find sufficiently supported by the evidence before me.

1. *Forms of the Diatom.*—The *Isthmia nervosa* has both a rhomboid and trapezoid form. The heavy costæ, or ribs, which give the name to the species, are found on the valves only, but not on the hoop. These nervures or costæ are very similarly arranged in all the frustules. Those of one valve are nearly parallel to each other, pretty regular in direction, running from the margin next the hoop to near the summit of the dome-like valve, where they reticulate with each other. Those of the other valve start from the margin in a similar way, but branch much sooner, and run together in a coarse network, of which the

most marked lines or ribs partially surround and isolate the nose-like projection of the valve, from which the gelatinous *stipes* exudes through the fine seive-like perforations, which here take the place of the much larger areolæ found on other parts of the valve. The costæ project boldly into the interior of the shell to a depth of about one-twelfth of its shortest diameter, and their interior arrangement about the point by which the diatom is attached, is such as to indicate, or at least strongly to suggest, a separate cell, having the office of secreting the gelatinous substance of the stipes or stalk. (Fig. 1.)

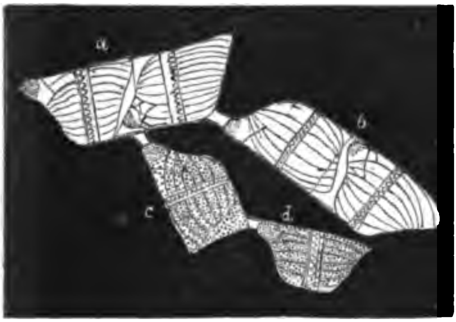

Fig. 1.

2. *Relative Numbers of the two Forms.*—The fission of the diatom is always transverse diagonally, the line of division running in such a way as always to divide a rhomboidal form into two trapezoids, and a trapezoid into one rhomboid and one trapezoid. From this it results that the number of trapezoids is largely in excess of the rhomboids, for, from the binary division of one of each kind, must result three trapezoids to one rhomboid. (Fig. 1, *a*, *b*.)

3. *Position of the Stipes and Point of Attachment.*—Assuming the point of attachment of the frond or filament to be its lower end, the valve with irregular costæ, which I will call the stipital end of the diatom, is always down. Thus, in a specimen in which division is complete, except that the two new frustules are still held within the elongated hoop of the original one, it will be seen that the stipital ends are in the same position, thus maintaining a general analogy to the positions of buds and stems upon any larger plant. (Fig. 1, *a*, *b*.)

4. *Modes of Connection in the Filament of Diatoms.*—The apparently capricious way in which the several diatoms are attached to each other is easily accounted for, since a single slide of the plant *in situ* will generally give specimens which mark nearly every conceivable step in their growth and separation. Bringing these steps together, we find that the simplest form of connection is that which occurs when the stipes of No. 2 attaches itself to the top of No. 1, their growth crowds them beyond the hoop, and the two remain as shown in Fig. 1, *a*, *b*. No. 2 may attach itself to the edge of the hoop of No. 1. In this case No. 2 is gradually crowded out of the hoop by the growth of its twin brother below, until its stipes can only hold on the very edge of the hoop, and the still further growth of No. 1 makes it turn outward until it takes the position shown in Fig. 1 at *c*. If, now, No. 1 completes a second division, No. 3 may remain attached to the others as shown above (Fig. 1, *d*), or may become loosened and fall off entirely, leaving the first two in a position in which the hoop of No. 1 projects beyond the frustule, and No. 2 remains attached to its side. Besides the various combinations and permutations of these modes of attachment, the loosened frustules may attach themselves wherever they may fall, either to the alga on which the colony lives, or to other diatoms amongst which it may lodge.

4. *The Hoop.*—I have already stated my accord with Dr. Wallich in finding the hoop composed of concentric elliptical tubes, sliding over each other like the draw tubes of a telescope. Indeed this is so obvious a fact that the most casual observer could hardly be excused for overlooking it. Not only is it shown by the thicker band about the middle of the diatom, when the areolæ of the different lamellæ of the hoop are confused by lack of coincidence with each other, and where, by focussing upon

either, the areolæ of that lamella may be brought out sharply, the other becoming dim; but at the sides of the diatom, where the curve of the hoop becomes nearly perpendicular to the line of vision, the double, and sometimes triple thickness, is seen almost as clearly as if looking at the edge of a longitudinal section.

But Dr. Wallich draws the conclusion that the hoop grows by addition of silex at the free margin, "much in the same way that the epiderm of the molluscous shell is secreted by the margin of the animal's mantle." My observations tend to establish a different conclusion, viz., that the growth of the hoop is in accordance with the laws of vegetable growth, rather than animal, and harmonizing with the theory of a membrane in which the silex is deposited, which membrane may be divided and split by the process of intussusception, or a new membrane may be formed within the old, from the protoplasm or live cell contents. Let us enumerate some of the facts bearing upon the question.

Upon almost any slide of *Isthmia* will be found numerous specimens, in which will be noticed not only the arrangement of the areolæ in the form of the quincunx, made by pretty regular diagonal rows, but the face of the hoop is divided by one or more lines of clear silex, running straight around the diatom, and breaking up the dotted field into two or more parts, as shown in Fig. 2, *a*. Bringing different individuals under the eye, one will soon be found in which this clear line has divided so as to show two smooth edges a little separated, as if the two halves of the diatom had broken asunder through the middle of the hoop. This suture, however, will be found not to cut clear through the shell, but the areolæ of an inner lamella will be seen below the opening, and upon one side or the other of it careful focusing will trace successively the faint outlines of other areolæ in an exceedingly thin film of silica, which fades away to invisibility as it is traced toward the junction of the hoop with the valve.

It may also be seen that when the opening of the suture is very small, the areolæ of the inner film have evidently slid from under the exterior ones, by the same distance as the opening of the suture, thus showing that they were before concentric, and suggesting (what further observation satisfactorily proves) that the same process of doubling the membrane or film has gone on upon the other side of the suture in the other half of the diatom, but is for the nonce invisible, because the adhesion of the films is undisturbed, and their areolæ remain concentric.

If the slide is rich in broken specimens (so often the most instructive), a little search will probably be rewarded by the discovery of a cast hoop in which, beyond the suture, the thin film above described is still adherent, not as a gradual tapering or diminution of the substance of the hoop, but starting from the edge of the suture by a shoulder, or sudden diminution of the thickness, which the light marks by a distinct line, beyond which the silica grows evanescent and the areolæ gradually fainter, toward the irregular and scarcely visible edge. (Fig. 2, *b*.)

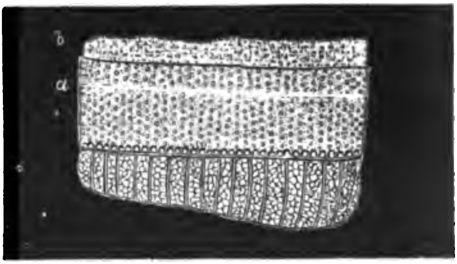

Fig. 2.

I shall presently give reasons for thinking that the separation of the parts of the hoop at the suture does not take place, when the diatom is growing normally, until the inner hoop has acquired its growth in thickness, and extends from valve to valve, or at least to the next suture above or below the one at which the division is supposed to take place; but the next point to be immediately noticed is that a similar suture occurs near the edge of the hoop where it connects with the valve, and when, by the growth of the diatom, the inner or outer hoop separates at that place, the line of the division can be plainly seen running across the large horseshoe-shaped areolæ which there form the characteristic marking of the shell. We thus have lines of suture always at the two extremities of the hoop, and, frequently, one, two, or even three, crossing it at intervals. The intervening sutures are not invariably present, but are found oftenest in the largest diatoms, and especially in those whose width is greatest in proportion to their length. The suture may appear on the inner hoop at a different place from that on the outer, or when none appears on the outer hoop except at its ends, and *vice versa*. This mode of "breaking joints" will at once be seen to be useful in strengthening the structure, and preventing the slightest accident from breaking the diatom quite in two in the middle. (Fig. 3, *c.*)

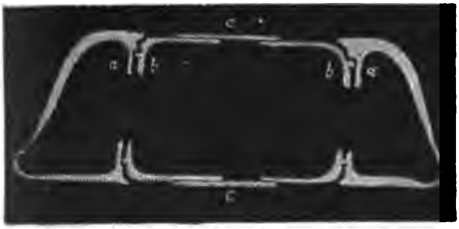

Fig. 8.

5. *The Connection of Hoop and Valve.*—Before proceeding further in the description of the manner in which the sliding of the telescopic hoops upon each other accommodates the growth of the diatom, it will be well to examine the structure of the connecting parts of hoop and valve, since these are very important items in the list of conditions which control the phenomena in question, and they do not seem to have been carefully examined or understood.

In the fully formed valve of the diatom, the edge next the hoop has a broad flange projecting inward, whose width is usually found to be about one-sixth of the shorter diameter of the valve. The costæ of the valve terminate in this flange or diaphragm, with a tapering curve reaching to its inner edge, thus supporting and strengthening it. Upon the valve, this flange makes a sharp right angle with the outer edge, or is even a little concave. The hoop has a similar diaphragm, buttressed and supported in like manner by the nervures of the large areolæ which mark the end of the hoop; the appearance of these so-called areolæ being, in fact, wholly caused by the nervures or braces which support the diaphragm, and having no real similarity to the areolæ which mark the general surface of the diatom, but are analogous to the costæ of the valves. The hoop diaphragm has one very important peculiarity, viz., that its inner edge is recurved or bent down over the edge of the valve diaphragm, with a lip of about the thickness of the latter plate, thus giving great firmness of connection, and effectually preventing lateral displacement of the parts. The hoop and its diaphragm do not meet at a sharp angle, as in the case of the valve; but the side of the hoop rounds into the diaphragm with an easy curve. The connection of the parts is shown diagrammatically, in longitudinal section, in Fig. 3, *a*, *b*.

I have occasionally found the diaphragm of both valve and hoop greatly widened, projecting into the interior of the diatom much further than common, so as to make a partition more than half closing the connection between the two parts. Its inner outline in these cases, is of the form of a broader ellipse, but it seems to have grown as a thinner film of silica, back of the ordinary diaphragm, or rather so extending from it as to leave the box-like fitting of parts, as shown in Fig. 8, so that the thinner portions are not in immediate contact with each other, as the thicker and narrower rims or flanges are. Upon these widened diaphragms the lines of the supporting nervures extend, as upon the narrower ones, but becoming fainter and wider as they go, giving a beautiful appearance of radial lines pointing to the open centre. (Fig. 4.)

It will thus be seen that the provision for a firm connection between valve and hoop indicates permanence, and the fact will be found in accordance with this. The valve and hoop nerve sever their connection at this place during the life of the diatom, and in the examination of a great number of individuals in which the separation has occurred, I have scarcely found half a dozen in which the recurved lip of the hoop diaphragm has not been fractured in places, thus indicating that the separation was by violence and not by natural causes. I regard it therefore as a settled point that the end of the hoop (including the large areolæ and the diaphragm) after it is once grown, never separates from its adjacent valve during the life of the diatom, but that all divisions by multiplication, and losses or separations of intermediate parts of the hoop, leave the connection between this and the valve undisturbed.

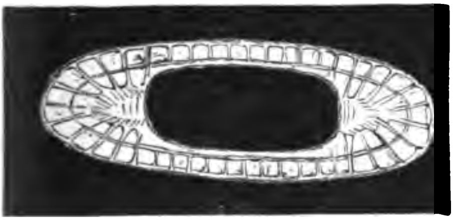

Fig. 4.

6. *The Formation of New Valves in the Growth of the Diatom.*—The diatom may properly be considered as having attained its full growth when its valves are so far separated as to leave room for the division of the cell contents into two, and the formation of two new and full-sized valves within the hoop. When this work is completed, we have no longer one diatom, but two, and their union from that time may be regarded as mechanical merely. The study of the dead specimens can tell nothing directly, about the formation of the nuclei and division of the endochrome. The growth of the siliceous film of the valve may, however, be traced by examples of almost every stage of its progress. It is found with the film so thin that it can only be discovered at all by its outline, where a portion of it is seen on edge, as it were. In these cases, no membrane could be conceived more delicate, appearing slightly crumpled by the pressure which the new valves, being back to back, seem to apply to each other by the growing force within. At this stage, no trace of costæ or areolæ can be seen. Soon, however, as a somewhat more advanced specimen is found, faint, hair-like traces of the costæ are seen. These are found soon to be more and more developed; areolæ, between them, begin to appear, and, finally, the fully formed valve, with its oval edges resting on the hoop diaphragm. The living force within each pair of valves would now seem to have gathered its energies for the next step, for we find the new valves separating from the old ones, and the pair of new diatoms severally growing as the parent did before them. In this separation the new valves leave the hoop diaphragm behind them, with its braces looking like large areolæ, and they each seem to be simply forced apart from the old valve by the growing force of the cell contents, as two pistons in one cylinder would be by steam injected between them.

To be continued.

Some Remarks Concerning P. T. Cleve and Moller's Diatoms. Upsala, 1877. No. 1–48. By. A. Grunow.

No. 1. I was not before aware that *Hyalodiscus Stelliger*, Bailey, was identical with *Podosira Maculata*, Sm., (*Craspedodiscus Stella*, Ehr. Microg.), and have learned it first by Prof. Smith's paper.* Although there are some things contradictory in Bailey's description, I think Prof. Smith is right, but I cannot agree with him in considering the widely distributed diatom, which I have mistaken for *H. Stelliger*, the *Eupodiscus* (*Actinoptychus*) *interpunctatus*. of

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*This journal, Vol. II, page 99.

Brightwell. Brightwell's delineation is that of an *Actinocyclus* without a marginal process, and is so very like the *Coscinodiscus fuscus* of Norman that I am much inclined to think both species are really the same diatom. It would be difficult to say whether it would be better to place this species among the *Actinocyclæ* or *Coscinodisceæ.*

The diatom in No. 1 of Cleve and Möller's collection is a variety (var. *artica*) of what I consider now *Podosira maxima*, Kg., (or *Hyalodiscus maximus*, if this genus should be retained); it is identical with *Cyclotella maxima*, Kg. Bacill., I, 5, for I have never seen any other diatom on algæ from Chili and Peru which agrees better with Kutzing's somewhat insufficient delineation; and my late friend, Eulenstein, who had seen Kutzing's collection, was of the same opinion. The fine hexagonal markings of this diatom, interrupted by irregularly radiating coarser punctæ, are so widely different from the coarse radiating granules, interrupted by regular double rows of blank spaces in *Eupodiscus interpunctatus*, and *Coscinodiscus fuscus*, that I think it quite impossible to unite the *Podosira maxima* to these species. The centre of *Podosira maxima* is occupied by an irregularly bordered wide space, less transparent, and more irregularly punctate than the rest of the valve. Sometimes this space is very large, as in the specimens I thought to be the true *Hyalodiscus stelliger* of Bailey, and sometimes very small, as in the specimens edited by Cleve and Möller, which resemble *Hyalodiscus cervinus* of Brightwell (Mic. Jour, viii, 5, 9). But in this species, the centre of the valve is convex, and in *P. maxima* the whole of the valve. *P. maxima* is nearly allied to *P. hormoides*, Mont. (not W. Sm.) and I am not quite sure they can be separated with sufficient distinctness.*

No. 2. *Hyalodiscus Franklini* (E), Cleve. This species is so nearly allied to *Podosira hormoides* of W. Smith, S. B. D., xlix, f. 32 (not Montagne), that it is impossible to define the difference. I propose the name *Podosira Franklini* for W. Smith's species (widely different from authentic specimens of P. hormoides of Mont. in my collection.) If the name *Hyalodiscus* is retained, it may be called as above (*H. subtilis*, Bail.); but this genus it would be better, perhaps, to abolish, along with many other genera of the *Melosireæ.*†

No. 18. *Staurosira æqualis* (Heib.) Grun. Prof. H. L. Smith expresses his doubts about the distinctness of the genera *Staurosira* and *Fragilaria.* I think they belong to different groups of diatoms, separate by nature of the endochrome. *Fragilaria* is a coccochromatic diatom, allied to *Diatoma, Meridion*, etc. *Staurosira* has much less divided cell contents, and is so nearly allied to Synedra that it is often difficult to decide in which genus a species should be placed.§

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*Herr Grunow, for whose opinion I have the greatest respect, is, I am quite sure, mistaken, in consequence of Brightwell's very poor representation of his A. interpunctatus. I do not, in so many words, say anywhere that Grunow's Hyalodiscus stelliger *is* the A. interpunctatus of Brightwell, though I do say that Möller has issued Brightwell's form under the name of H. stelliger. And as for Cleve and Möller's No. 1, I only remark that, "Whatever it may be, it is not the form called H. stelliger by Bailey." However, as Möller no doubt depended upon Grunow for nomenclature, I can see that the latter considered my statement as impugning his judgment, a thing I should hesitate to do. Indeed, if Grunow had not seen Brightwell's specimens, there would not be much difficulty in understanding the mistake, for, as mentioned above, Brightwell's figure is very poor. Eulenstein gave me slides, which he had received from Brightwell, of the very material from West Indies, in which the latter found the A. interpunctatus, and there can be no doubt of its identity with the form issued by Möller on the Typen-Platte as H. stelliger. As for Coscinodiscus fuscus of Norman, it is an entirely different diatom, as coarsely marked almost as the so-called Eupodiscus Ralfsii, to which Norman himself likens it, and differing only by wanting the inter-marginal nodule. It occurs abundantly at Melbourne, and in the Yarra Yarra River, Australia.—H. L. S.

†Hyalodiscus subtilis, Bail., occurs always as a single diatom, attached to the algæ precisely like Arachnodiscus and Coscinodiscus, and never in a filament, as Podosira. I am not quite clear about the propriety of abolishing this genus.—H. L. S.

§It appears to me that it would be much more difficult to decide if we relied upon M. Paul Petit's distinctions of "Coccochromatic" and "Placochromatic," which, certainly, can never be applied except when one examines living specimens. The diatom in question is plainly Fragilaria capucina, or a variety thereof, and, if I may be allowed to judge from my own drawings, one of the "Cocco-

No. 20. *Berkeleya Dillwynii*, Grun. This preparation is mixed with a great many frustules of *B, fragilis*, Grev., (or, better, of *B. micans*, Lyng.), but it contains also the true *B. Dillwynii*, easily known by its much smaller size. A representation of the valves of *B. Dillwynii* will be found in my paper on the Novara algæ, and of *B. fragilis* in my paper on Honduras diatoms in the Mic. Trans., London, October, 1877, S. C. xcv, f. 15. W. Smith's delineations of the latter species resembles *N. Scopulorum*, Bréb.

No. 24. *Navicula gigas*, E., is very rare in this sample of Nova Scotia deposits, which contains principally *N. dactylus*, E.

No. 25. *Stauroneis amphoroides*, Grun. I fully agree with almost all Prof. H. L. Smith says about this number, only I do not think that the true *Amphora membranacea* of W. Smith, S. B. D., ii, 29, is quite identical with *A. Ostrearia*, Bréb., of which I have authentic specimens from Courseulles. W. Smith's delineation is that of an *Amphora* with very fine striation, and less complex connective membrane, which I have occasionally seen, and possibly it may be considered as a Stauroneiform variety of *A. obtusa*. The other delineations of *A. membranacea*, Sm. (Pritch., T., vii, f. 51; M. J., vi, 3) belong to *A. Ostrearia*, Brèb., which has 11–13 striæ in 0.01 mm., and is very like *A. lineolata*, E., differing only by the lateral dilation of the central nodules. To *A. Ostrearia* are allied *A. Porcellus*, Kitton, var. *Novæ Caladoniæ*, Grun., *A. decussata*, Grun., etc., but in some instances, it remains dubious whether these species are not stauroneiform varieties of others. As one of my specimens of *A. Ostrearia* contains the *A. quadrata*, Bréb., I can state here that this little known species seems to be quite identical with *A. laevis*, Greg.*

No. 28. This contains a smooth variety of *Eunotia denticulata*, Bréb., of which I have examined authentic specimens, The "denticulæ" are not undulations of the dorsum of the valve, but a row of somewhat prominent granules on the convex side of the valve. The form which I mistook for *E. denticulata* in my paper on "Banka diatoms," (Rabenhorst Beitrage) is a variety of *E. Camelus*, E.

No. 29. The small *Cymbella* in this preparation is perhaps the true *C. Amphicephala*, Naeg., and quite identical with *C. Naviculæformis*, Auerwald, (Rab. Alg. Europ., No. 1,065), but not with Heiberg's delineation, which shows no trace of the smooth area around the central nodules, very conspicuous in Auerwald's authentic specimens. We may call the form delineated by Heiberg *C. amphicephala*, Naeg., (see also A. Schmidt Diat. Atlas, T. ix, 62, 64) and retain the name *C. Naviculæformis* for Auerwald's species (see Schmidt's Diat. Atlas, T. ix., 63). The latter is closely allied to *C. Anglica*, Lagerstadt, *C. cuspidata*, W. S., (not Kg.), and perhaps a small form of it.

No. 30. *Cocconema Kamtschaticum*, Grun. This species is not allied to *C. cistula;* its nearest relation is *C. Mexicanum*, E., (if the form delineated in Schmidt's Atlas is Ehrenberg's species) and with which it i perhaps best to be united, as it differs on by its somewhat finer markings, and smaller size—it, together with *C. Stomatophorum*, Grun., (*G. gibbum* ? ? ? E., not *Cymbella gibba*, Bailey), and *C. Australicum*, Schmidt, to a little group of *Cocconemeæ* (or *Cymbelleæ*), having the central nodules crossed

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chromaticæ," but there seems to be little reason for separating this from other of the Fragilarieæ, *e. g.* F. mesolepta, which is as plainly "placochromatic," and much closer allied to Staurosira. The name Staurosira, as a distinctive one, was intended to comprehend such of the filamentous species of Fragilarieæ as had inflated valves.—H. L. S.

*Herr Grunow judges from the poor figure in S. B. D. I have a slide labeled A. membranacea, which was examined and marked by W. Smith himself. It contains specimens which differ as to the width of the striated part of the valve (the canoe shaped part of Ralfs) between the figure in S. B. D. and that of Roper, copied by Ralfs, in Pritchard; and the striation in this authentic specimen is almost exactly that mentioned by Herr Grunow for A. Ostrearia, viz., 28–33 in .001 inch (= 11–13 in .01 mm. very nearly.) I am pretty sure that the genuine A. membranacea of W. S. is therefore Brébisson's A. Ostrearia.—H. L. S.

by a small transverse channel, which is not to be found in *C. cistula* or *C. gastroides.**

Nos. 34, 35. *Cocconema parvum*, W. S. This is the *C. pachycephalum*, Rab., and only a small variety of *C. cymbiforme.*

No. 37. *Encyonema hebridicum*, Greg. I think this is *Cymbella hebridica*, Greg., but cannot certainly say so. It is nearly allied to *C. maculata*, W. S., *not* Kg., and *C. turgida*, Greg., and these are so nearly related to *Encyonema caespitosum*, that I think it will be better to place them in this genus. I may state also that *Cymbella Scotica*, W. S., is a form of *Encyonema gracile*, Rab., *Cocconema gracile*, E.*

No. 40. *Gomphonema robustum*, Grun. According to Prof. H. L. Smith, this is a stout form of *G. herculaneum*, E., and the latter a variety of G. capitatum, E. I do not know *G. herculaneum*, and cannot tell if it be different from *G. Oregonicum* and *G. mamilla*, E. The delineations of these three species are much alike, and represent diatoms of greater size than my *G. robustum*, which is a distinct species, as far remote from *G. capitatum* and its allies as possible. The striæ of *G. robustum* are dense (10–11 in 0.01 mm.) very delicately punctate, somewhat radiating, and traversed by two longitudinal lines, which I have not observed in any other *Gomphonema*, and which Ehrenberg would have seen and delineated, if his *G. herculaneum* were the same species. *G. Oregonicum* and *G. mamilla*, E., are similar, but stouter, and wanting the longitudinal lines of *G. robustum.* The striæ of both of them are composed of two rows of very minute granules, and so differ from the striæ of all other species of *Gomphonema.* *G. capitatum*, E., and its many varieties, are so nearly related to *G. constrictum*, that it is impossible to define the limits between them; the striæ are more or less interrupted in the middle of the valve (not so in *G. robustum*) and more distinctly granulate. From *G. capitatum* several varieties of W. Smith and others must be separated, as I shall state more in detail in a paper on Caspian Sea algæ, which is in preparation.†

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*The whole genus Cymbellæ needs revision. There is not a shadow of doubt that Ehrenberg very often, and Kutzing less frequently, described the same diatom under different names, and different species under same name! and so, to a certain extent, "authentic specimens" lose their value, and W. Smith, in the "British Diatomaceæ," has again, described and figured, as typical forms, many species of the earlier authors wrongly. Indeed, an instance of the uncertainty in names is furnished here, where No. 31, labeled as Cocconema cistula, is now stated by Grunow to be mostly composed of C. helvetica (a species not named at all, in the printed list accompanying the slides, as present in this preparation). Herr Grunow is right in this correction, *i. e.* as these species are generally understood, but I should be very unwilling to consider the distinctions as really specific. In fact, the permissable varieties would allow all the forms in this preparation to be grouped under one specific name, which might be, as well as any other, "Cistula." Kutzing's Cymbella maculata scarcely differs from the smaller more inflated forms in this slide, which Herr Grunow considers as the true C. cistula, judging from the preparation in his "Decades," and except that one was observed by Kutzing stipitat, and the other free, there *is* no difference. Rabenhorst, in the preparations issued by him, has blundered in the most reckless manner. In the "Diat. Exsiccat., 1871," Nos. 24 and 25, respectively labeled Cymbella ventricosa, Ag., and Cymbella gibba, Rab., are the same, and are both Encyonema caespitosum free; and his Cocconema cymbiform, No. 20, is the variety generally called C. parvum. If Herr Grunow (and no one is better able) will prepare a monograph, and give *good* figures, or, better, can induce Möller to arrange a typical series of the Cymbelleæ themselves on one slide, illustrating and defining permissable species, we might hope for some deliverance from the confusion in nomenclature which leaves every one at liberty now to name a specimen just what suits the fancy. Bailey's Cymbella gibba, from Honey Valley Lake, of which I have the original, is distinct, but the figure in L. W. Bailey's paper on "New Species from the Para River," gives an impression of rather more delicate striation than it really has. Of course the specific name must be abolished; it is the Encyonema triangulum of Grun. Bailey's figure shows the median lines much too strongly curved. —H. L. S.

*C. gracile, E., if I may judge from specimens from Brébesson, is Cleve's No. 33 Cymbella delicatula.—H. L. S.

†I have sent to Herr Grunow specimens of G. herculaneum from various localities, and think he will modify his opinions materially when he studies them; he has been misled by Ehrenberg's figures. The two longitudinal lines, to which he alludes, are not real, but are due to flexures in the valve, and are quite apparent in some of the specimens (single valves) of G. herculaneum. One of the gatherings, which was collected during the Colorado explorations under Prof. Hayden, shows forms passing from G. capitatum, W. S., into G. herculaneum, and also of the peculiar variety called here G. robustum. The striation is also the same. English specimens of G. capitatum, from Dr. Ar-

No. 41. *Gomphonema balticum*, Cleve, allied to *G. tenellum*, W. S., but not of Kutzing, which is the smallest form of the *G. olivaceum* group. The G. tenellum of W. Smith is nearly allied to *G. parvum*, Kg.

No. 42. *Gomphonema calcareum*, Cleve. This is a widely distributed form, resembling the preceding species, but having a somewhat coarser striation. It belongs to a large group, including *G. dichotomum* var. B. W. Smith (*not* Kutz.), *G. capitatum* var. B. W. Smith (*not* E.), *G longiceps*, E., and some others.

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The Preparation of Rocks and Fossils for Microscopical Examination.

BY R. FRITZ-GAERTNER, PH.D.

IT is often supposed by those who have never prepared sections of rocks or fossils that the process is associated with great difficulties and expenditure of time, but this in reality is not the case. A small amount of practice is needed for the beginner, and he may soon be able to manufacture sections which are fit for the microscope. The time spent in the mechanical operation of grinding rocks is not only remunerated by interesting and instructive preparations, but adds also to a complete knowledge of their physical structure, gained by a close observation of the various features they present during the process of preparation.

In cases where large numbers of sections are to be prepared, it is not possible for the lithologist or palæontologist, for want of time, to perform all the work himself: he may be assisted by any person of ordinary ability in the preliminary part of preparation. Those who do not personally wish to prepare sections can be referred to Mr. Fues, of Berlin, or to Mr. A. A. Julien, School of Mines, New York city, who prepare and deal in sections, which, on account of their perfection, deserve commendation.

In the present article I wish to describe the process of preparing rocks or fossils for microscopical study. They are mainly intended for those who design to make sections themselves, and to whom a detailed description of a mechanical operation may be of some assistance in their first attempts.

Selection of Rock Material.—It is quite important, in order to make a complete microlithological analysis of rocks, to select material which is characteristic. Most rocks are in various states of alteration; it is therefore necessary to choose fragments both from the fresh and decomposed parts, as thin sections of the latter ones are just as important and instructive as those taken from parts in which no visible change has occurred. Usually such decomposed rocks are very fragile and crumbling, because their crystalline structure or their cementing medium has been destroyed by the process of decomposition. Before undertaking to grind them their firmness must be restored. The fragments of such decomposed rocks are at first well dried, and then placed in liquid Canada balsam, which is exposed on an iron plate to a gentle heat till it has filled and penetrated the pores and fissures of the rock. They are then separated from the Canada balsam and laid upon the warm iron plate till the balsam proves to be hard when cooled down, and are then capable of undergoing the process of slicing or grinding.

Apparatus.—It consists in its most simple form of some plates of iron and glass about eighteen inches square, to allow a full stroke with the arm during the grinding process. They have to be perfectly even and flat. Emery of various degrees of fineness is required to be used on the plates with an addition of water. Fragments of rocks are ground by hand and treated, as will be described in the following lines:

In the New York State Museum of Natural History at Albany, where a large number of rocks and fossils have to be cut and prepared for thin sections for illustrating

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nott, have 27 in .001 inch, G. herculaneum 27 in .001, and I make the specimens of G. robustum, in Prof. Cleve's slide No. 40, 28–29 in .001 inch (*i. e.* about 11 in .01 mm. Since writing the preceding, I have received the original material sent to Ehrenberg by Bailey, and marked by Bailey G. herculaneum; it contains all the varieties between Ehrenberg's figure and the G. robustum.—H. L. S.

the Palæontology of New York, the slow process of grinding by hand had to be abandoned, and a small boiler and steam engine of two and a half horse power were purchased for the purpose of using steam power for the grinding and slicing operations. The grinding apparatus is formed by two circular iron plates (A and B) of eighteen inches diameter and one-half inch thickness, which rotate horizontally with a velocity of about 300 revolutions a minute. The slicer, which is used to cut the rock in certain directions, or to separate from it small slices to be ground afterwards, is a thin copper or steel disk of twelve inches diameter, and turns also horizontally with the same velocity as the grinding plates. For rocks above hardness 5, another slicer of steel is used, which turns vertically, and which is fed with diamond powder moistened with oil.

The whole apparatus may be run at the same time, and is arranged in such a manner that no one operation interferes with another.

The grinding and slicing is performed by the aid of emery, which is constantly applied to the plates and slicer with a brush held in the left hand. The plates are kept wet by a small current of water. It is important to use emery of different but uniform degrees of fineness as the work progresses. A mistake usually made by beginners is to choose a too coarse emery, in order to hasten the work of grinding, but they soon discover that all their sections break and wear off long before being half finished. It is advisable to use for the coarse grinding on plate A an emery which can be bought in any drug store as emery No. 90 (A). Plate B is charged with flour of emery (B); it serves also to prepare one or two sorts of finer emery from it, by treating a certain quantity of the flour with water in a vessel which may be about three feet high and six inches in diameter. In stirring the water, the emery becomes suspended in it; after a lapse of fifteen minutes, the water with emery which has not settled down during this time is decanted in a similar vessel, and left there for twenty minutes more, when the water may be drained off. A sediment of fine emery will thus form in the latter vessel; and after having repeated the process for some time, the emery sediment (emery C) is taken from the vessel, dried and bottled. Its degree of fineness is expressed by the number of minutes, which is in this case fifteen minutes.

Canada balsam serves as a cementing medium; it also is used to increase the transparency of various sections. It should be entirely clear and not of yellowish tint. Usually a solution of Canada balsam in turpentine is employed to mount such rocks as will not undergo any change in heating them gently over a warm plate of iron. For rocks which cannot be exposed to any heat, a solution of pure Canada balsam in chloroform is used. Both solutions of Canada balsam should be well bottled to prevent evaporation.

Object Glasses.—The slides of glass which are intended to bear the section should be entirely clear, free of any color, air bubbles, or any other enclosures, as those which are used in other branches of microscopy. Their size should be uniform. Prof. Zirkel, of Leipzig, the distinguished lithologist, has proposed and introduced the following size, 45 mm. by 25 mm., which is preferable to the ordinary 3 by 1 inch, as a slide 45 mm. by 25 mm. can be rotated on the table of the microscope; besides they are less liable to break in dropping them, and also take up less room.

In the New York State Museum of Natural History the slide measuring 45 mm. by 25 mm. is adopted. As it was found that this glass slide was too small for a number of sections of fossils, which exceed the usual size, two other standard sizes were introduced which are in proportion to the first. Size B is twice the size of first = 50 mm. by 45 mm. Size C is twice the size of second — 50 mm. by 90 mm. It would be of great advantage if a uniform size was introduced in the various collections of those who prepare sections. The slide 45 mm. by 25 mm. is generally adopted with lithologists and palæontologists both in America and Europe.

Process of Slicing and Grinding.—The fossil or rock is at first marked with a pencil, and afterwards with a file, in the direction in which it is designed to be cut. It is then held with the right hand without any further apparatus, in such a direction that the revolving slicer will cut the specimen according to the marked line. The slicer is constantly supplied during the operation with flour of emery and water. If there is plenty of material and no special direction needed, small slices can be separated from the rock by a heavy blow with a hammer. The rock fragments should, as a rule, not be beyond the size of a twenty-five cent piece; of course it is of great advantage to prepare sections which offer a large field for observation, and the rock specimens should not be chosen too small, as they lose in size during the grinding process.

The slice of rock which has been separated either by the slicer or by the heavy blow with a hammer, is gently pressed with the right hand against the turning plate A, while the left hand supplies plate A with emery A and water. It is necessary to change constantly the position of the rock-slice in the right hand, in order to grind it to an even and plain surface. The slice is then well rinsed and cleaned of any particle of emery A, and then transferred to plate B (emery B) where the grinding proceeds till its surface is free of any scratches. Being cleaned of the emery B, it is brought upon glass plate C (emery C) and ground till its surface is entirely smooth. The rock section is finally well rinsed and brushed to clean off all impurities and allowed to dry.

Mounting Process.—A slab of iron two and a half feet long, four inches broad and half an inch thick is laid horizontally upon a tripod (of iron) and heated with a Bunsen burner. The glass slide on which the rock fragment is to be mounted is well cleaned and laid upon a part of the slab which is of a constant and moderate heat; after being warmed a few drops of Canada balsam are placed upon the glass, and left with it on the slab till the balsam, by evaporation, has assumed a tenacious condition, in which its films will not adhere much to the fingers, and yet be pliable enough to be bent readily without breaking. The warmed mineral slice is now laid upon the Canada balsam with its ground face down, and allowed to remain on the slab till all air bubbles have disappeared below the slide in the balsam. It is then gently pressed on the glass, and then taken off and allowed to cool. It is of great importance to use Canada balsam in its above described condition, as the rock section during the process of grinding thin, unavoidably breaks to pieces in case the balsam proves to be too soft, and if on the contrary it has been too long exposed on the slab it will become brittle, and the section will, during the grinding, be liable to break off. The loosened mineral slice must in such a case be laid into a dish with turpentine to dissolve the balsam, and after being well cleaned is mounted again as described. There is no considerable difference in the process of mounting with balsam in solution with chloroform or with turpentine. The balsam in chloroform is allowed to harden in a warm room: it usually needs one or two days, while the solution in turpentine by application of heat hardens in from five to ten minutes. In the latter case care should be taken not to heat the balsam too quickly, as it turns yellowish on account of a partial carbonizing.

Grinding Operation.—After having used all necessary precaution in cementing the rock fragments to the glass, the grinding manipulation now begins on the reverse side of the section. It is ground at first on plate A (emery A), then on plate B (emery B), till the section commences to be translucent, or till it is so thin that it is not advisable to continue the process on the rotating wheel. It is, of course, only a matter of experience to know how long to use the various wheels, as much depends on the consistency of the rock material. It is advisable to discontinue the use of plate B before the slice is too much reduced in thickness, so as to allow a further treatment on glass plate C with the fine emery C. Due precaution should be employed so as not to grind the section uneven. To avoid this the position of the section should frequently be changed in grinding. The section is ready as soon as it is thin enough to allow a complete study of its texture and its component parts, of which a preliminary examination under the microscope will be the best test.

Process of Covering and Remounting.—The section is well rinsed and brushed to remove any emery which might have remained on the glass, or which may be accumulated in the pores or fissures of the slice. It is then laid in a vessel with turpentine, in order to dissolve the excess of Canada balsam around the slice. In a few minutes it will be softened enough so as to be easily removed by a gentle brushing with turpentine, after which it is well washed and then dried with chamois leather. In order to protect the section, and also to increase its pellucidity, it is usually imbedded in balsam and covered with a thin glass, the thickness of which should not exceed 0.25 mm., to allow the use of a high magnifying power.

Usually the glass slide on which the mineral slice has been cemented to grind it thin, becomes partly ground during the various operations. It may be replaced with a clean slice on which the mineral slide is mounted as already described.

The separation of the section from the original glass is done by gently heating it till the Canada balsam becomes softened enough so as to allow the removal of the section by a slow sliding to a vessel with turpentine. The heating should be done very gently, otherwise a crust of hard Canada balsam will form around the sections, the removal of which by aid of turpentine or any other dissolving medium will be most difficult.

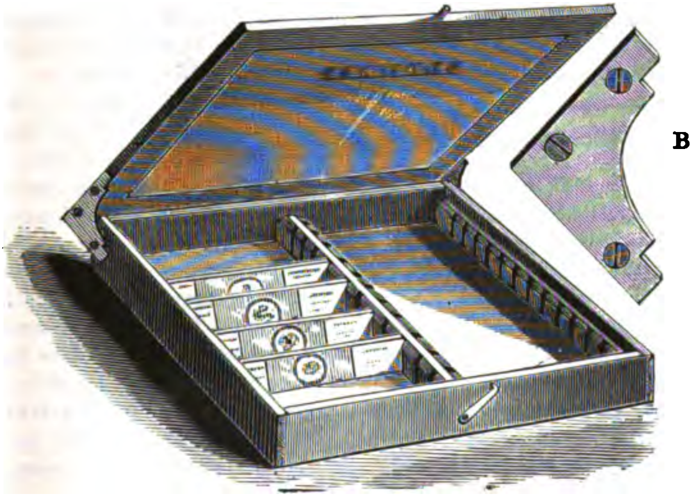
Another method consists in laying the glass with its slice in a dish with turpentine, and to leave it there till the balsam is entirely dissolved, after which the slice of rock may be separated from its glass without any difficulty. The thin slice is transferred to another dish with turpentine, and left there till it proves to be entirely free of any foreign matter. It is then taken from the vessel with the point of a knife, rinsed with alcohol and dried, afterwards mounted on a glass which has been warmed, when the slice may be placed upon it with a few drops of Canada balsam.

The whole operation of transferring needs great care, as some mineral slices will prove to be very fragile on account of their thinness. Sections which are made of a rock material which needed a preliminary treatment with Canada balsam to make it firmer would break entirely to the smallest fragments in the attempt to remove them to another glass, and have therefore to remain on their original glass. Before covering them, the greatest care should be taken to free them entirely from any Canada balsam around the borders of the mineral section, and also from emery, which sometimes can only be detected by aid of a magnifying glass. The re-mounted mineral slice, or the one which could not be removed, as stated above, is covered with a few drops of Canada balsam and laid again upon the warm slab till the balsam has obtained the required tenacity. A thin cover-glass, corresponding in size with the mineral slice, is cleaned with alcohol and warmed; it is then taken up with a pair of forceps and dropped slopingly on the slice, so as to exclude any air. The section is left on the warm slab till all air bubbles have disappeared which may have been enclosed between the section and cover glass; the latter is gently pressed upon the section and then allowed to cool. Care should be taken to place the mineral slice and cover glass in the centre of the glass slide, which will contribute to a nice appearance of the finished preparation. The surplus of Canada balsam around the cover glass is cleared off by brushing it with turpentine, then it is well rinsed with water, and after being dried it should be labeled at once. The labels should be applied on both sides of the preparation and inscribed with the name and locality and geological group of the prepared material. It is well to number the sections and record them in a catalogue in which also a description of the most interesting and principal features of each mineral slice may be given, which will facilitate a future study of the section.—*American Naturalist.*

A New Box for Microscopic Slides.

BY CARL SEILER, M. D.

THE usual methods of keeping mounted objects in boxes, either upright in racks, or flat on trays, have a great many disadvantages. It is true that a great number of slides may be packed into a very small space by using the rack system, but to find one individual slide among the multitude of parallel glass edges staring at one from a well filled cabinet of this kind, is very distracting, and causes a very great loss of time. And when by good chance the slide is found, it becomes a matter of some difficulty to get it out. When the slides are kept on trays lying flat, an object is easily found, and if the tray or drawer is made so that the slide can be tipped at either end, it can also be easily taken up; but the slides are apt to slip over each other, especially when in drawers, and thus many a valuable specimen has been spoiled. This can be obviated by providing a special compartment, so to speak, for each slide, but the price of the cabinet is then, of course, very materially increased, if not doubled.



NEW BOX FOR MICROSCOPIC SLIDES.

In order to overcome these difficulties, and especially for the purpose of utilizing as a pocket case for slides a leather case, which I possessed, and which was of no use to me, I made racks in the sides of the case, which slant at an angle of 130° to the bottom of the box. The slits were cut a quarter of an inch apart, and I was thus enabled to place ten 3 by 1 slides in a case 6 by 3½, and only five-eighths of an inch in depth. The slanting direction of the slides enabled me to read the headings of the labels, and also brought the edges of the slides so far apart that there was no difficulty either in finding any particular slide, or in lifting it out. A large cabinet, with twelve drawers made in the same way, gave great satisfaction and saves a great deal of time in hunting for a specimen, although it contains several hundred slides. For putting up small cabinets of twenty-four slides each, I adopted the same plan, as may be seen in the engraving.

As these boxes were intended to be carried about, it was desirable to make them as light as possible, and in doing so it was found that the ordinary hinges could not be used to connect the lid to the box, on account of the strain being too great for the thickness of the wood. I therefore used a corner hinge of rather novel construction, which answers the purpose admirably, and at the same time gives a finish to the box. It is shown at B in the figure, and is fastened by three screws, two of which are screwed into the lid, while the third is screwed into the side of the box. Upon this screw the hinge turns, and swings the lid back and over the edge of the box. The lid hinged in this way, slips, when opened, partly under the box, lying flat on the table, thus all strain on the wood is avoided. The figure B on the right gives a representation of one of a pair of these hinges, natural size.

Photo-Micrography.

BY E. RIEDEL.

PHOTO-MICROGRAPY, or the art of photographing the enlarged image of microscopic objects, is one of the most useful inventions in natural science, since it shortens the laborious work of hours into seconds, executing the delineations of the wonders revealed by the microscope with greater exactness than the most conscientious draughtsman.

Any good microscope can be utilized in photo-micrography, though the final results of a good instrument will undoubtedly eclipse those obtained with a combination of inferior lenses.

The tube of the microscope requires a careful examination, to see whether the inside is thoroughly blackened or not. In the latter case, apply shellac varnish mixed with lampblack, in order to remove every trace of a reflecting surface. This black varnish is easily made by mixing the two ingredients together; a few trials, however, will be necessary to test whether it produces a dead surface. The lampblack is advantageously moistened with alcohol before the shellac varnish is added. To test the varnish, take a piece of tin and give it a coat of your black varnish. It will dry in a very short time. If the painted tin shows any trace of a shining surface, add more lampblack. Should, however, the surface be dead black, rub your finger over it, to see whether the paint, by a slight friction, will come off. In the latter case, a little more shellac varnish is wanted in the paint.

Examine, also, your eye-piece, and the objectives, and proceed with them, in case of necessity, in the same manner.

Objectives of a very short focus (less than 1-5th of an inch) render the focussing of the magnified picture rather difficult; objectives of a longer focus are therefore preferable. The same magnifying power can be obtained with them by simply increasing the distance between the microscope and the photographic camera.

The penetrating power of a lens of short focus is entirely lost when the magnified picture is thrown on the ground glass of the camera box, and the only remedy for this evil is to employ lenses of longer focus with a small diaphragm.

The character of the eye-piece is of secondary importance. Achromatic combinations, though far superior to common lenses, may be dispensed with. The eye-piece can even be removed when the object has to be magnified to but a limited extent.

In regard to the choice of objects for photo-micrographical purposes, but few directions for the proper selection will be necessary. Objects with well-defined outlines are more easily photographed than those in which such a distinction is absent. Sections of any kind should be as thin as possible, the thicker the section, the longer should be the focus of the objective. The color of the object is of less importance. Yellow objects, especially dark yellow ones, require a longer exposure (sometimes two or three minutes) to produce a good negative. But the same rule applies also to the other colors, when these are of a darker shade.

The other apparatus necessary for photomicrography is a camera, and the materials used in ordinary photography. The tube with the lens is removed, and the horizontally inclined microscope is connected with the front part of the camera in such a manner that the optical axis of the microscope forms a right angle with the central part of the ground glass. Or, in other words, the microscope takes the place of the photographic tube.

A very practical way to proceed hereby, and with a single accurate adjustment dispense with any further trouble in making the connection between the microscope and the camera, is the following: Procure a piece of board with an entirely level surface (a drawing-board answers very well), large enough to accommodate the camera, with the horizontally inclined microscope placed before its front. Draw lines parallel to the sides of the board at equal distances about one inch apart and at right angles to each other. On one end of the board are nailed two strips of wood at a distance apart which is equal to the exact width of the camera, so that the latter can be firmly squeezed between them. The camera should stand precisely over the central longitudinal line. The microscope is placed directly in front of the camera on the central longitudinal line. The tube of the microscope should run parallel to the drawing board, and the foot of the instrument should reach equal distances from the central line. Usually a few small pieces of board will have to be nailed under the microscope till the horizontal position is accurately obtained. Such an arrangement, when once carefully made, is permanent; it can be put aside, the camera and the microscope can be removed from the board when they are not used for photographing, and in less than a minute the whole apparatus can be placed in working order without any great inconvenience.

To be continued.

Dr. Carpenter on Angular Aperture.

THE practical problem of angular aperture may be thus stated: Resolution is of great importance; penetration is of great importance; but these two qualities cannot be combined in same objective, except at considerable sacrifice of one or both. In view of such antagonism, what is the best possible selection of objectives that can be made by one able to buy a tolerably complete set? Dr. Carpenter offers us the following solution in "The Microscope," page 205: "For almost every purpose, except the resolution of diatoms, objectives of *moderate* angular apertures are to be decidedly preferred." As to what he means by moderate, we are able to judge from a sentence on page 208, where he says that "his own experience would lead him to prefer an angle of 40° for the 1-2 inch, and of 75° for 1-4 inch." We have now to consider whether Dr. C. counsels wisely or not. Let us begin by eliminating as many side issues as possible. We are to find out what is *best*, not what is best for a man of limited means. We have, therefore, nothing to do with questions of economy. We must, of course, throw out of the discussion all second-class glasses. Whatever be the angle, no objective can be admitted that is not as perfectly corrected as possible. Finally we have no need to consider objectives of lower power than the half-inch, for they are not made with angles sufficiently high to injure penetration. We have left, then, first-class objectives from 1-2 inch up, in the consideration of which the expense question must not be raised. It will be convenient to begin by comparing a 4-10th inch with a 1-4th inch of 75°. I have a Tolles' 4-10 of 100° giving, with all eyepieces, powers from 100 to 1,000 diameters. With 1-2 inch eye-piece (power of 500 diameters), illumination and definition are both very fine. With 1-4th inch eye-piece (power of 1,000 diameters), illumination and definition are both good. I never yet saw daylight poor enough to render a 1-4th eye-piece useless. In fact, I make almost if not quite as much use of this eye-piece as of any other—not only in difficult cases of resolution, but in ordinary work where I want good definition, with high power and long working distance.

As to illumination and definition of this 4-10th inch under low power eye-pieces, they seem almost toe fine for common use. (I consider brilliant illumination to be very important, for the reason that, in very many cases, good definition of object cannot be obtained without it, no matter how perfect the corrections.)

As to resolution, it is sufficient to say that the 4-10th resolves *P. angulatum* in balsam finely.

As compared with a 4-10th of 100°, the 1-4th of 75° is deficient in no less than four particulars. (1) It cannot define as well, except under lowest eye-piece, on account of (2) field not being as well illuminated. (3) It cannot show details of structure (resolution) as well, although it may resolve just as difficult tests. (4) It cannot afford as high a power, nor as low. The 1-4th has the one advantage of being somewhat more penetrating.

I might now compare a 1-6th of 180° with a 1-10th or 1-12th of medium angle, say 130° and 150°. Such comparison, however, would only show that high angles are superior to medium in every particular, except that of penetration.

This has just been shown, however, by above comparison, nor do I see how it can be denied that penetration is a quality standing apart from and not able to be well combined with the other desirable qualities of an objective, whereas these qualities hang together, becoming better with increase of angle, worse with its decrease.

But penetration is important, and ought to be secured, not in moderate amount, but in as great perfection as possible. How can we secure it, and at the same time retain all the advantages of high angles? By a very simple plan. Let all objectives (from 1-2 inch up) designed to secure penetration, be made with as low angles as will permit use of medium eye-piece. Such glasses ought only to be used when we desire to learn solid forms, or where relations of parts are hard to make out. Let all other objectives be made with highest angles compatible with best possible corrections. (I think *highest* angle compatible with best corrections, if only first-class opticians be entrusted with the work.) Our conclusion, then, is somewhat at variance with that of Dr. Carpenter. He advises nothing but medium angles, thus gaining little and losing much. We advise no medium angles, thus gaining everything and losing nothing. In illustration of the plan, I submit the following as being a tolerably complete set of glasses, allowing, however, that many more might be added on same plan, and with advantage in special cases: 2 inch; 1 inch of 30°; 4-10th inch of 100°; 1-4th inch of 50°; 1-6th inch of 180°. With one inch you get powers up to 400 diameters; with 4-10th to 1,000; with 1-4th to 600; with 1-6th to 4,000.

W. G. Lapham.

Northville, Mich.

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Aquaria.

A writer in *Science Gossip* relates his experience with aquaria as follows: "I have kept a great number of aquaria, both salt and fresh water ones. I have often watched the sticklebacks, both salt and fresh water, and both sorts are very fond of attacking other fish, particularly the fresh water species. The latter attacked goldfish, roach, dace, minnows, and other kinds of fish, as well as newts and tritons. They nibble the tails and fins off the fish, particularly the goldfish, and the fish get diseased through it, and pine away and die. I have lost a great many goldfish by their depredations. They nibble or bite the toes and tail off the newts: I have seen their tails bitten so frequently by them that there has been very little left of them. I should never advise any one to place them in a nice-stocked aquarium, and they should be kept out of small ornamental ponds where there are goldfish. If you wish to see how destructive they are, place some of those fish or animals that I have mentioned in an aquarium by themselves; you will then see that the sticklebacks will not let them rest a minute; they will worry the poor fish to death."

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Microscopical Congress.

IT is proposed to hold a Microscopical Congress next August at Indianapolis, at which it is expected that all the prominent microscopical societies will be represented. This Congress, if it should meet with general support from the microscopists of the country, cannot fail to effect much good. It ought to bring together all the prominent workers in the country, make them personally acquainted with each other, and develop by discussion many points of great interest. We are satisfied that many of the discussions which have stretched to great length when conducted by correspondence only, might have been settled satisfactorily by a very short personal interview.

We are happy to say that the meeting promises to be largely attended. Particulars in regard to the arrangements which have been made, may be found in a circular which may be had by addressing Dr. W. W. Butterfield, Indianapolis, Ind.

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The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

A Chapter on Elementary Physics.

DEDICATED TO PROFESSOR HITCHCOCK.

Part First.—The Sun. "The luminous orb, the light of which constitutes day; the central body around which the earth and planets revolve; a celestial body which can be seen almost any fair day through a piece of smoked glass."

I beg my friend to read the above little monograph on elementary astronomy carefully, noting any want of accuracy therein apparent. Assuming his compliance with this request, I go on to say that just after *sundown* this evening, my attention was called to his really kind notice of myself, as well as my Dunkirk lecture. Allow me to assure you, my dear Professor, that although we have been pulling at opposite ends of the rope for some months, the generosity I have experienced at your hands has been vastly in advance of what I could have returned, and has placed me in position to receive any criticism that you might offer with the best possible grace.

I now propose to jerk *my end* of the rope in a manner that will make things lively with you! The fact is, when I get after you with a "sharp stick," you become unusually brilliant with the jerk responsive! I like it.

I admit that you are one "who *demands* accuracy of expression in every branch of science"—"that the scientist has *no right* to say what he does not mean, and he has *no right* to presume that his readers will understand him if he uses incorrect language." I therefore have placed the above little monograph on elementary astronomy at your service, and in timely season, fearing otherwise you might be led astray by my use of the word "*sundown*"—you will see the point. It's true that Joshua of old commanded the sun and moon to stand still, and the story is found in a book generally admitted to be a classic, but—no matter.

Now, Professor, I fear that you do not practice what you preach; for I read (page 92), "if this question were put to a thorough physicist * * * knowing nothing about balsam or fluid mounts, etc.," Isn't there an "impossibility" here? A thorough physicist knowing nothing, etc. There's a screw loose somewhere.

Right on your next line is another jumble. *Here is* a want of accuracy or what not—which is it? You say, "Must the scientist be led by the nose," etc. If this expression *is* accurate, I want you to tell me just how this kind of a thing is accomplished; give me the p-r-a-c-t-i-c-a-l details, just as it would be done in the flesh, including the "adopt" and the "teach"—before an audience, too, without "apology"—and the "why" of it. "It's *the right and duty* of every man of science to ask this little question *whenever it occurs to him.*" "The scientist has *no right* to say what he does not mean." Let us have the facts.

Part Second.—180°, Plus 180°, 180° + 45°. It is true, my dear sir, that in my Dunkirk lecture I did use the words "plus 180° of aperture." Now that select and intelligent audience (comprising physicists who *did* know something about "balsam angles,") so far from demanding an "apology," generously and unanimously gave me a vote of thanks. Curious, wasn't it? I remember well my delight in there meeting the veteran Dr. J. W. Armstrong, Principal of the Fredonia Normal School, and one of the leading educators of your State, another physicist, too, who *can* talk intelligently as to "balsam angles," and who has made the apertures of objectives an especial study, and who afterwards became one of my most valued correspondents. Nor did we have any quarrel about the "plus 180°." Most of the audience had read about Joshua, and doubtless would not baulk at such expressions as "sunrise" or "sunset."

After all, Professor, admitting that the "plus 180°" might have courted some such gentlemanly criticism as it finally got from you, I reckon I was as near right as Joshua! But before I can lift you over this stile, I must scoop you up! get you together in some shape, so you can be handled. First of all, you seem to put the 180°, plus 180°, 180° + 45°, all in one boat together; you regard them as synonyms. And, secondly, I have to learn some things from you.

Messrs. Tolles and Spencer you denounce because they mark their objectives 180°, which you say is not only "impossible," but "absurd," and that one of these gentlemen (you don't say which) attempts to lead the scientist "by the nose." And you further say that one of them (I don't know which, again,) "might as well add 45° to said 180°.

Well, here is material enough to commence on. Now, my dear Professor, you maintain it to be the "right and duty" even of every man of science to ask this little question whenever it occurs to him (the "why" part, you know.) That I have been engaged in a controversy with you for months, demonstrates my claim as a "man of science." You can't dodge that, and the "occur" part is present and up to the high-pressure notch.

Now, I want to know "why" it is that 180° of aperture is impossible; "why" that plus 180° of aperture is impossible and absurd. We have your assertions, *but minus the ghost of a demonstration.*

Why do you accuse Messrs. Tolles and Spencer of perpetrating acts that are absurd and impossible; and *why* do you venture to hint that one of these gentlemen attempts to "lead scientists by the nose," (whatever that may mean). The names of Spencer and Tolles are revered by American microscopists, and their unrivaled efforts in the improvement of object-glasses have won for them a world-wide reputation. The chances are that they know more of microscope optics than you and I put together; and these are the men who mark their objectives "180°." *Why* should there be "a law to prevent it?"

Now, Professor, if this 180° is impossible and absurd, will you kindly inform the readers of this journal *what* figures Tolles and Spencer ought to engrave on their wide-angled objectives in place of the awful "180°." Will you be kind enough to name the extreme angle immediately adjacent, but not *contacting* the impossible and the absurd?

Again I read, "plus 180° does not mean 97° balsam." Did I assert this? Now, I ask *what* does 97° balsam mean? Let's have it, and the "why" thereof. Unless you can tell me *exactly* what the 97° balsam angle *is*, I shall not take any stock in your above assertion.

Once more: you say that "true apertures can be measured and definitely stated." I wish that you would tell Mr. Wenham how the thing is done; he tried for a whole year to measure one of Tolles' objectives, without getting any two results alike! But I am after *you*, not Wenham. I desire to learn from you precisely what what "true aperture" is. When thus taught, then I desire to know by what physical process the same can be measured—"definitely," you know. "Accuracy" is the thing we scientists want.

Now, my dear sir, I call on you to answer all of these interrogatories, and when you shall have proven that 180°, plus 180°, or 180° + 45°, are one and the same thing; when you shall show that Messrs. Tolles and Spencer are asserting absurd and impossible things, and more, are trying to lead scientists by "the nose;" when you shall prove that a thorough physicist can know nothing of balsam or fluid mounts; when you shall have demonstrated that I should have apologized to my Dunkirk audience; when you shall have proven what 97° of balsam angle is; ditto as to "true aperture," and how to "definitely measure" the same—then and not until then will I take the "plus 180°" under advisement. Meanwhile we will be good friends, and with Gen. Grant say, "Let us have peace." Don't omit reading the reprint of Wenham's article on angular aperture, pages 74 and 75.

J. Edwards Smith.

Homœopathic Hospital College, Cleveland, O., May, 1878.

A Museum of Microscopes.

Ed. Am. Jour. Microscopy—I desire to call attention to the fact that in the Army Medical Museum at Washington a nucleus exists of a Museum of Microscopes, ancient and modern; and also to invite possessors of instruments rendered practically valueless by the march of improvement, to deposit them as gifts in the institution named, and thereby aid in forming a collection which shall illustrate the history and development of the microscope.

Of course, contributions will be of all sorts, but chiefly of the very old and quaint forms which almost induce mirth by the singularity of their mountings and the brevity of their performance. But they teach instructive lessons, awaken the liveliest interest, and excite wonder at the imperfect means and astonishment at the great work done by rare intelligences with such feeble aids.

I hope, Mr. Editor, that you will favor the appeal, and give this note a place in your valuable journal.

Christopher Johnston, M. D.

Baltimore, May 7, 1878.

Collar Adjustment Again.

Ed. Am. Jour. Microscopy—Dr. Blackham has pointed out in his last letter that Mr. Tolles has never claimed to make objectives in which collar adjustment produced no change in focus. He quotes a passage from Frey, and I take occasion to say that my impression was that the passage made particular reference to Mr. Tolles. I am glad to be corrected, and my apology is that I wrote from memory, and have no copy of the work at command. I nevertheless insist that there is a great misunderstanding among microscopists as to the merits of this new adjustment, as I have good reason to know.

Dr. Blackham seems determined to place me in a wrong light in the matter, for his letter would lead one to suppose I had said something demanding a column and a half of criticism, while in fact his letter has merely enabled him to indulge in innuendoes.

Prof. J. E. Smith's letter in the March number is a very curious one. I reply merely that I am sorry the Professor is led to believe I meant the opposite of what I said. As long as I have the support of such a man as Mr. Wenham, I do not fear to speak out, and Prof. Smith need not accuse me of any underhand mode of attack. If, on page 66, he means to say that casts are sometimes so delicate as to be overlooked by direct light, I can only say it is contrary to my experience, and I would be greatly obliged to receive from him a specimen of such casts which cannot be found by a 1-5th marked 110° with direct light. Even bacteria must be very small and delicate to escape detection by one accustomed to seeing them.

Romyn Hitchcock.

Polarization by Refraction.

Ed. Am. Jour. Microscopy—The article in the April number by Mr. Peet on this subject will doubtless attract much attention, and many, like myself, will probably fail to secure the brilliant effects which he describes. Before this last article was published, I had tried the same experiment, following his previous directions as closely as possible, and failed then as now.

True, there are certain appearances of color and a fine black ground, but there is nothing which approaches the beauty I was led to expect from the descriptions given. Perhaps the use of a condensing lens would afford me better results, but as none is at hand, this cannot be verified. While perfectly ready to admit that the whole fault may lie in my manipulation, or possibly in the conditions afforded by my instrument, as Mr. Peet suggests, I would like to call attention to the explanation. I am at a loss to understand how there can be any effect of polarization in this. How Fresnell's discovery bears upon the subject is not clear. Upon this discovery Fresnell's rhomb was made to produce circular polarization, but it will be noticed that in order to produce this circular polarization two reflections are required, both internal, and the incident ray is originally polarized in one plane. It is the reflected ray that becomes polarized, and a ray passing through the slide to illuminate the object, as in the cases Mr. Peet mentions, cannot be thus polarized. But there is much more in the article which is not at all clear. For instance, when he compares the circular stage of polarization with the crossed tourmalines of the polariscope. Why should circularly polarized light give a black field? The field is in fact dark, because the light from the mirror is thrown beyond the aperture of the objective. He tells us a small portion of the polarized light passes through the slide, and up through the objective to the eye, but makes "no impression on the optic nerve!" How can these things be? Firstly we are instructed to produce a dark field by moving the mirror to one side. In doing this, as we all know, the light is merely thrown outside of the objective. Therefore it certainly does not enter the eye at all. Secondly, if light consists of vibrations of ether, to which the eye is sensible, how can these reach the eye and produce no impression?

To take another step, admit that the light is polarized, and that the crystal, or diatom, or other object, affects it in the manner represented, where do the colors come from? Illuminate any crystal with polarized light, and no color is seen, but look at it through another polarizing prism, and the case is altered. I fail to understand how the object can act both as analyzer and polarizer, as Mr. Peet seems to say.

Having written more than it was my intention, I will simply add that the effect appears to my mind simply one of oblique illumination, and the colors are produced by interference of waves, caused by refraction, or reflection, from minute points; the exact nature of the phenomena it may not be easy to determine.

It is but right to remind the reader that Mr. Peet did not commit himself to the explanation given, but invited criticism, which is offered in the same friendly spirit. Nevertheless the practice of offering ill-considered opinions on scientific subjects may be productive of much mischief, and is to be deplored, particularly in cases where it is easy to lay them before scientific men for approval or criticism.

R. Hitchcock.

April 24, 1878.

Volvox Globator.

Ed. Am. Jour. Microscopy—This evening I have devoted to the examination of the beautiful *Volvox Globator*, the first it has been my lot to see. Two friends and myself found a rich lot of them on a marshy prairie in Hyde Park, just south of this city. We gathered a good supply, and promised ourselves a rich treat for the evening.

While watching them under the glass, as they would come rolling along with their peculiarly graceful motion, one came into the field that looked a little strange. On close examination, I found a live rotifer (I think it was a small *Rotifer vulgare*) contained in the hyaline membrane. I was using a binocular with a 3-4 inch objective, and of course it did not take long to decide by focusing that the rotifer was really inside of the envelope. The *Volvox* was a good lively specimen, and as it was continually rotating, I had good opportunity to examine all parts of the membrane, and at no place could any abrasion be detected. There were eight young colonies inside the parent envelope, three of them in their normal state, while the other five seemed to have had their envelopes ruptured. Whether this damage had been caused by the rotifer, it was impossible to say, but think it fair to attribute it to him, as I saw no damaged young in any of the others. On consulting Pritchard, I find on page 527, fourth edition, this statement: "Ehrenberg noticed the peculiar occurrence of living rotatoria within the globes of *Volvox Globator*. Mr. John Williams has communicated (T. M. S. 1851, iii) an interesting observation confirming Ehrenberg's account." Thus it seems that it has been noticed before, but I think the cases of sufficient rarity to put each one on record.

H. F. Atwood.

Chicago, May 12, 1878.

[The cases in which rotifers are found in the interior of the *Volvox* are by no means rare. At page 18 of Vol. I of this journal, a correspondent describes almost the same phenomenon so graphically detailed by Mr. Atwood. The same thing is referred to at page 135 of our little book, "How to Use the Microscope."—Ed.]

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The Scale and Vernier Improvement in Stands.

Ed. Am. Jour. Microscopy—In my letter of March 30, in reference to scale and vernier on the microscope, I said, "The device * * may have been used by others, * * though I did not then know of such a case." Since then I have received from M. M. L. Bowens, of Brussells, Treasurer of the "Societe Belge de Microscopie," an extract from the bulletin of that society, in which he describes and figures this device, and states that he has had it in use about ten years. The February number of the "Journal de Micrographie," (Paris), contains a letter describing this form of scale and vernier attachment, but giving more prominence to other devices for the same purpose, notably the use of a large divided disk attached to the pinion of the coarse adjustment.

Mr. Wenham, in the article on angular aperture, published in your journal for April, just received, states that he uses the scale and vernier on his stand.

It would appear then that I was not the first to devise or put into practical use this extremely convenient accessory, Mr. Bowens' claim antidating not only the time at which I devised the scale and vernier attachment and had it applied to my stand, but also antidates Mr. Fell's "suggestion" to Prof. Smith in April, 1876.

It seems strange to me that so useful an accessory should have been in use for ten years, and yet no mention be made of it in any text book or catalogue that I have been able to examine.

Geo. E. Blackham.

[The device described is one which has never come into *general* use, and consequently whenever it has been applied to any microscope, it has been at the special suggestion of the individual owner. A gentleman who is well known to the microscopical world, but who does not wish his name introduced into this controversy, writes us that he had nearly the same thing applied to his own stand many years ago. These facts do not detract from the merits of those who reinvented this device, but they render any further discussion of the subject unnecessary.—Ed. A. J. M.]

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Current Notes.

Another Ferment.—A chemical question which has caused much discussion for years, now seems in a fair way to be solved by the microscope. It is a well-known fact that nitrogenous substances in soil, or under proper conditions elsewhere, have their nitrogen rapidly oxidized to nitric acid while undergoing decomposition. Numerous explanations of this action have been offered, but thus far all have failed to give entire satisfaction. The latest results seem to indicate that a ferment takes place in the operation. The details of the experiments are not at hand, but Schloesing and Muntz, followed by other investigators, have found that those agents, such as chloroform or heat, which kill or prevent the growth of plants, also arrest this action, and that a soil in which all organisms are destroyed by heat will not cause oxidation of this kind, so long as it is protected from germs, but the addition of a very little common soil will start the process. It does not appear that the specific plant engaged in this important operation has been isolated as yet. If there really is such a ferment, it must be widely distributed and of vast importance.

Postal Library.—Mr. James P. Burbank, of Salem, Mass., proposes to establish a library from which members in any part of the Union can obtain books by mail. The idea is a good one. For particulars address Mr. Burbank.

Cheap Boxes for Slides.—Mr. E. Line, of Rochester, New York, makes a very cheap and efficient box for holding slides for temporary purposes out of button boxes and crimped tin. The crimped tin is such as tinsmiths use for biscuit and cake cutters. The alternate crimps form the grooves in which the slides rest.

TRANSACTIONS OF SOCIETIES.

Note.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

American Microscopical Society.—At the annual meeting of the American Microscopical Society of the City of New York, held Tuesday evening, March 26, 1878, the following officers were elected for the ensuing year: President, John B. Rich, M. D.; Vice-President, Wm. H. Atkinson, M. D.; Secretary, O. G. Mason; Treasurer, T. d'Oremieulx; Curator, John Frey.

O. G. Mason, Secretary.

State Microscopical Society of Illinois.—The annual meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, April 26, 1878. President Henry W. Fuller in the chair. The minutes of last meeting were read and approved.

Donations reported were six very fine injected preparations, sent by Dr. Seiler, of Philadelphia, and Transactions of the Belgium Microscopical Society.

Reports were read by the retiring Secretary, Treasurer, and Librarian, followed by a short address by the President, in which some recommendations were advanced tending towards the future prosperity of the society.

A communication from Indianapolis was read, asking the co-operation of this Society in the contemplated Congress of Microscopists, to be held in that city, commencing Aug. 14, 1878. Messrs. Thomas, Peabody and Colgrove were appointed a committee to correspond on the subject, and take such steps as should seem fit in the premises.

The election of officers for the ensuing year resulted as follows: President, Henry W. Fuller; Vice Presidents, Harvey M. Thompson, H. F. Atwood: Secretary, Prof. S. H. Peabody; Corresponding Secretary, James Colgrove; Treasurer, B. W. Thomas; Trustees, E. W. Blatchford, Prof. E. S. Bastin, W. H. Summers, Lester Curtis, M. D., Samuel J. Jones, M. D.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, April 4, President Hyde in the chair. The meeting was a most enjoyable one, and the rooms were well filled. Among those present were Dr. Harkness and Mr. Edwards, honorary members; Mr. Scupham, corresponding member, and as visitors, the Rev. John J. Bleasdale, F. G. S., from Melbourne, Australia, and Dr. Blake, of this city.

After the election of Dr. J. T. Boyson to resident membership, the following additions to the library were announced: Frey's "Icones Selectæ Hymenomycetum Nondum Delieneatorum," Parts 1 and 2; "Science Gossip," for 1876 and 1877, and the current numbers of "Nature," "American Naturalist," "Popular Science Monthly and Supplement," "Grevillea," "Flora," and "Science Gossip."

The Rev. Mr. Bleasdale created a stir of pleasure by a fine gift to the society of a dozen of Dr. Carpenter's own slides, mounted by and bearing the handwriting of that great leader in microscopic research. All eyes were busied for many minutes in eager examination of these early working slides of the illustrious microscopist; some seemed to be the very originals of the illustrations in his standard work on the microscope.

A cordial vote of thanks was given to Mr. Bleasdale for this gift, of such historic as well as intrinsic value.

Father Bleasdale exhibited one of Swift's pocket microscopes, a wondrously compact little affair, almost microscopic in two senses, furnished with an inch and a 1-4 inch objective. The striations of muscular fibre were easily seen with it.

The evening was evidently to be an instrumental one, for President Hyde produced a 1-4 inch objective, manufactured in every particular, from lenses to brass work, in San Francisco. It was made by Mr. Frank Wilkins, who formerly worked for Ross in England, but now is with Mr. John Roach, of San Francisco. Upon comparing the objective with a Smith & Beck's 1-4, it was found to be fairly equal to it in every respect. The members found a new confirmation, added to the many which California has furnished, that "Westward the course of Empire takes its way."

To have founded and maintained a microscopical society on the very western edge of this continent, where the specimens for an evening's seance may have been collected during the day in primitive forests, and where society is passionately bent on money-making, must be a source of just satisfaction; but that the time has come when, in our own city, Mr. Wilkins can equip the members of this society with the most intricate product of optical manufacture, should certainly fill them with enviable pleasure.

President Hyde also surprised the members with the results obtained with his periscopic B eyepiece, by Gundlach, the first one of this improved kind made.

The only formal communication of the evening was a verbal one by Mr. Clark, who spoke of recent investigations in the sponges and infusoria, which add still greater strength to the theory of his father, the late H. James Clark, that the sponge is a compound, flagellate infusorian, as against the theory that it is a single individual in which the collar and flagella bearing monads are simply tissue elements, like ciliated epithelium. This latter theory Haeckel strenuously supports in the interests of his celebrated Gastraea theory, but he does it in the face of all facts except those coming from his interpretation of the so-called "ciliated larvæ," and other interpretations favorable to Prof. Clark's view, have been reached by Russian, French and English observers (see Barrois, Metschnikoff and Kent) not bound to support a Gastraea theory.

Kent, in the "Annals and Magazine of Natural History," January, 1878, describes a solitary collar-bearing monad, in which he has discovered the function of this peculiar collar. It is a wonderful food-trap. The currents of water created by the flagellum carry particles of food to its exterior slimy surface; they adhere, and, by a continuous motion of the collar upon the outside, down within, and finally into the sarcodebody the food is conveyed, as it were, by an endless revolving belt. Can all this complexity of function belong to a mere tissue element?

The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, May 2, President Hyde in the chair. Mr. George T. Folsom, of San Francisco, was the visitor of the evening. The current numbers of the Cincinnati "Medical News," AM. JOUR. OF MICROSCOPY, "Science Gossip," "Quarterly Journal of Microscopical Science," "Nature," "American Naturalist," "Popular Science Monthly," and "English Mechanic," were placed upon the table, with two interesting additions to the cabinet of diatomaceous earths—one of local deposits from Santa Monica and Santa Cruz, given by the California State Geological Society; the other, a suite of seven European deposits from Italy, Bohemia and Jutland, received in an exchange with Mr. R. Hitchcock, of the New York Microscopical Society.

Mr. Clark, the Secretary, was instructed to notify diatomists, through the leading microscopical journals, that the Society is now enabled, by the kindness of the State Geological Society, to offer return exchanges of our Pacific coast diatomaceous deposits on receipt of any valuable microscopical material.

After deciding that the annual reception of the Society should be held on the 23d inst., a vigorous condemnation was expressed by several members upon the action of New York and other postmasters in requiring letter postage upon diatomaceous material, and the conversation then passed to the National Microscopical Congress to be held this summer in Indianapolis.

Dr. Mouser, referring to a blackboard sketch, briefly described his microscopical cabinet. [A detailed account of this cabinet will appear in our next issue.—ED. A. J. M.]

Mr. Charles W. Banks, Corresponding Secretary, produced much pleasure by exhibiting side by side, Beck's recent National Monocular, and a monocular of sixty years ago, described in an accompanying pamphlet as "Carpenter's Improved Compound Microscope for Opaque and Transparent Objects." The curious phraseology of this pamphlet excited much amusement. The "sliders," as they were called, were ivory slips, each containing several objects, held in a row of circular openings by mica discs. A pair of "tongs" was provided to take up any small objects. Achromatic object-glasses, and the Huyghenian eye-piece had then just come into use, and the describer speaks of them with no little emphasis. The general impression was one of considerable surprise at the good workmanship of the instrument, and the results given by one of its objectives.

Mr. Williams spoke of some curious larvæ-like bodies swarming in a recently dead hog, and Mr. Kinne was appointed to examine the case.

The insects which are injuring so many of our fine cabinet woods cannot be too thoroughly studied, since only by learning their habits can any escape from the expensive pests be reached, and Mr. J. P. Moore read the following paper, extending his observations from the laurel wood to the madroño borer:

"I herewith present you samples of our common madroño, arbutus menziesii, which, as you will perceive, has been badly bored by an insect. I first detected the work of this insect in a young madroño, the heart of which had been bored for a great distance. In general it prefers the dead to the living wood. Owing to the very large size of the larva, as well as of the mature insect, the boring is very damaging. In fact, many of the holes are nearly, if not quite, a half inch in diameter. I do not bring this before you as a new insect—it is the well-known clytus conjunctus—but simply as an instance of another borer at work in our forests, hoping that such as can, will observe the work of this class of insects."

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Marine algæ for the herbarium; Northern N. E. and Florida species particularly desired; named species, for dried algæ of those sections. M. A. Booth, Longmeadow, Mass.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 852, Worcester, Mass.

Slides of the sugar mite, amœba diffluens, and foraminifera, in exchange for good material, or well mounted slides of interest. Clark M. Elliott, Auburn, N. Y.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

British plants and bird's eggs for American ditto. J. A. Sanford, 289 Summit street, Toledo, Ohio.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 186 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of manzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Wanted, in exchange for a number of fine slides, the polarizing apparatus for a first-class stand. Address F. F. Stanley, 40 Pearl St., Boston, Mass.

Gomphonema germinatum, a pure gathering of "Challenger" soundings, Globigerina, etc.; also, 8 European earths. Good marine and guano diatoms, unmounted, wanted in exchange. W. M. Paterson, Westfield Terrace, Loftus, England.

Mounted or unmounted crystals of tartaric, oxalic, red prussiate, chloride and bichromate of potash, for other objects of interest. Address H. B. Hargreaves, Garnerville, Rockland County, N. Y.

Slides of black rust on wheat stalk, opaque and transparent; stained fertile frond of Adiantum pedatum, etc., for other mounted objects. Address F. H., Drawer 35, Cherokee, Iowa.

Slides of spores of botrychium, and fossil diatoms from Bow, N. H., for other mounted objects. Lists exchanged. Wm. W. Griffin, Lynn, Mass.

Slides of cuticle of larva of Macrosila Carolina, showing crystals, in exchange for other objects. E. A. Burdick, Pension Office, Washington, D. C.

Palates of mollusca, a great variety, mounted or unmounted, in exchange for mounted slides of interesting objects or good material. C. M. Vorce, 164 Lake street, Cleveland, Ohio.

Slides of Arachnoidiscus Ehrenbergii, *in situ*, on seaweed from Santa Cruz, Cal., and Aulacodiscus Kittoni (transparent), for other mounted objects. C. Mason Kinne, No. 422 California street, San Francisco, Cal.

Specimens of the marbles, granites and minerals of Vermont, in exchange for Western minerals, or good fossils; minerals and fossil woods from the far West specially desired. Dr. Hiram A. Cutting, State Geologist, Lunenburgh, Essex county, Vt.

Mounts of Uric Acid (natural urinary deposits) in exchange for other mounted objects of interest. Address W. J. Weeks, Homœopathic Hospital College, Cleveland, Ohio.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, JUNE, 1878. No. 6.

Abdominal Tumor Found in Domestic Fowl.

BY R. W. CORWIN, M. D.

THE man who works out of doors in the pure air and sunlight, who takes enough exercise to digest the food he eats, and to circulate his blood well, who lives in a clean house, and keeps himself clean, is generally healthy.

Now, place this man in a small dirty room, poorly ventilated and lighted, allow him to take no exercise, and compel him to live upon dainties, and, last and worst, give him no opportunity to cleanse himself, and you will soon find him pale, emaciated and sick. The poisonous germs from filth will impregnate his system, set up a process of decomposition, and unless freed from these terrible influences, the result will inevitably be death.

Not only is this the case with man, but any animal subjected to these influences will be similarly affected. Persons who frequent menageries or zoological gardens, if at all observing, cannot help noticing that those animals in the gardens are much healthier looking, their hair smoother, eyes brighter, and steps stronger than those shut up in filthy little pens.

"The horns of a male deer (*Cervus canadensis*), during the voyage from America, were badly developed, but subsequently, in Paris, perfect horns were produced."[*]

It is plain that the same imperfect hygienic influences that affect the health of man, will affect the health of animals below him.

Do animals below man have the same or similar diseases as those attacking man?[†] One has but to turn to the literature upon diseases of domestic animals to convince himself that this question should be answered in the affirmative.

It may seem strange to many to think of horses, sheep or dogs having toothache, and having their teeth filled; or having paralysis of the lips or tongue, croup, bronchitis, boils or erysipelas! Yet these afflictions are imposed upon poor helpless creatures, as well as upon man. Every stock breeder and poultry raiser has, to his sorrow, learned these facts. Even the poor fowl has its share of ills.

To illustrate this more fully, I wish to direct the attention of my readers to a description of two tumors taken from a hicken, and presented to me last winter. t the same time I wish to show how sim lar these abnormal growths are to those occasionally found in man. The following history and information of the external appearances of the chicken, and the locality of he tumor, which I will first describe, I obained from my friend Dr. White, who eared and dissected the unfortunate fowl.

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[*] Darwin, "Animals and Plants under Domestication," Vol. II, p. 141.

[†] See Gamgee on "Our Domestic Animals in Health and Disease."

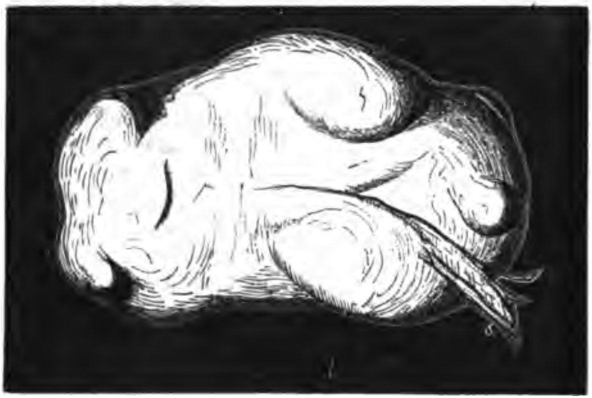

Fig. 1.—CYSTIC TUMOR FROM ABDOMEN OF A FOWL. *a*, the portion by which it was attached.

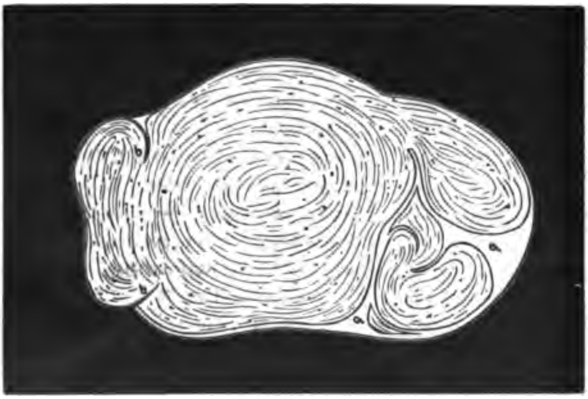

Fig. 2.—A SECTION THROUGH THE TUMOR REPRESENTED IN FIG. 1. *a*, *a*, Complete partition. *b*, Partial partition.

In the winter a chicken was selected from he Doctor's flock and killed for domestic urposes. During the process of dressing he fowl, his attention was called to an abnormal appearance in the abdominal region, which he recognized at once as a tumor. It pitted on pressure, and apparently occupied the greater part of the abdominal cavity. Student-like, he appropriated the specimen to mental instead of gastric food, and at once began a careful dissection of the parts involved. The abdominal epidermis and muscles were somewhat distended, but otherwise normal. The intestines were normal, but pressed forward. Beneath the intestines lay a tumor, the size and shape of which is represented in Fig. 1. The tumor was perfectly movable, being only attached to the longest transverse process of the sacrum on the right side by a band of connective tissue, as seen in Fig. 1, *a*. The tumor projected forward of the process to which it was attached, and considerably to the left of the median line, giving the abdomen, externally, quite a symmetrical appearance. With one exception, which will be hereafter mentioned, the chicken seemed perfectly healthy. A slight peculiarity in its movements while walking had been noticed, but it created no suspicion of abnormality.

The walls of the tumor were thin, and composed of simple connective tissue. A section in a plane through its longest diameter, displayed a new feature. As seen in Fig. 2, *a*, *a*, a complete partition had been formed, and at *b* a partial division existed. These inner walls were thicker and firmer than the outer ones, otherwise between the two there was a close resemblance.

The microscopical structure of the contents of the tumor is shown in Fig. 3. The whole mass had a soft yellowish or waxy appearance, giving off a very strong odor, resembling that from fæces of the fowl. The contents consisted of fat cells, granular matter, and crystals of cholestearine.

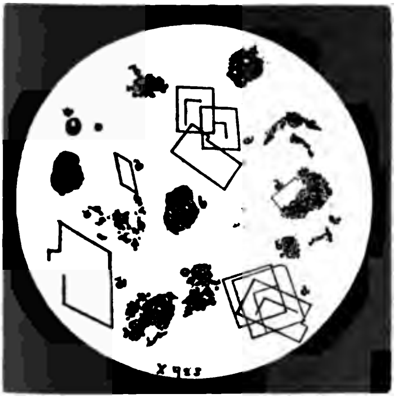

Fig. 3.—CONTENTS OF THE CYST REPRESENTED IN FIG. 1. *a*, *a*, *a*, Fatty globules. *b*, *b*, *b*, Granular matter. *c*, *c*, *c*, Granular matter around fat globules. *d*, *d*, *d*, Crystals of cholestearine.

The fat cells, Fig. 3, *a*, *a*, *a*, separated readily, and floated quite freely about the field of the microscope. The granular matter, Fig. 3, *b*, *b*, *b*, had a marked tendency to collect in patches or about the fat cells, Fig. 3, *c*, *c*, *c*. Occasionally, however, a field would be seen where the finely divided particles were quite evenly distributed over the surface of the glass. The large rhombic and transparent plates of cholestearine, Fig. 3, *d*, *d*, *d*, which took on their characteristic forms, made up a considerable portion of the tumor. The origin of cholestearine has not as yet been explained. It is known that it exists in many tissues of the body, particularly the nervous, and in many kinds of food.*

"Cholestearine is new recognized as a normal constituent of various tissues and fluids of the body. * * * It is usually described as a non-nitrogenized principle, having all the properties of the fats, except that of saponification with the alkalies."†

In abnormal cystic growths of a fatty character, where the contents of the cyst has little or no chance for carrying on changes from without, and remains stagnant for a long time, cholestearine crystals, which are set free from the fat are generally abundant.

The manner by which this is accomplished is not as yet fully understood. "This much, however, we must hold fast, that cholestearine is a product set free at a late period from stagnating, and particularly from fatty matter."‡

It will be readily seen by those acquainted with pathological formations, that probably the growth at first was simply a fatty tumor, which became incysted, or, more properly speaking, the original thin walls of connective tissue became thickened somewhat similar to a case mentioned by Paget,§ which may have severed all blood supplies, causing to an extent the well marked degeneration. This would account for the presence of free cholestearine, and for the fetid odor.

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*Dalton's Phy., 6th Ed., p. 76.

†Flint's Phy., p. 446.

‡Virchow's Cellular Path., 1st Am. Ed., p. 400.

§Paget's Surgical Path., 3d Ed., p. 449.

It is not by any means an unheard of thing to find. in man, tumors which have undergone similar changes to those above described.*

The second abnormality to which I wish to refer, connected with this fortunate (scientifically speaking) fowl, is a growth which was developed upon the right pectoralis major muscle. It was cystic in character, but quite different from the one above described. It lay imbedded in the subcutaneous tissue; perfectly movable, and of the size and form represented in Fig. 4. At *b*, a fatty membrane projected, by which the tumor was more firmly attached to the surrounding tissues. The walls were composed of simple connective tissue cells, and owing to the thinness of the walls and the contents of the tumor, a bluish color was given to the whole mass.

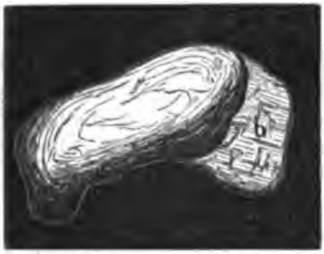

Fig. 4.—CYSTIC TUMOR FROM RIGHT PECTORALIS MAJOR OF FOWL. *b*, Membrane by which it was attached.

A section removed from one side of the cyst revealed a compact, pasty body, of undeveloped feathers, appearing as though it had been moulded into a spindle-shaped form by artificial means, so smooth and symmetrical was it externally.

The contents of the cyst, though very friable, left the walls as readily as the pulp of a banana leaves its rind.

This portion of the tumor, where viewed through the microscope, displayed some very pretty structure, as is represented in Figs. 5 and 6. In Fig. 5, *a*, *a*, *a*, may be seen portions of barbules quite perfectly formed. In many cases the oval cavities were plainly visible, while evidently the outer portions, which were destined to form the cortical substance, had become more or less granular.

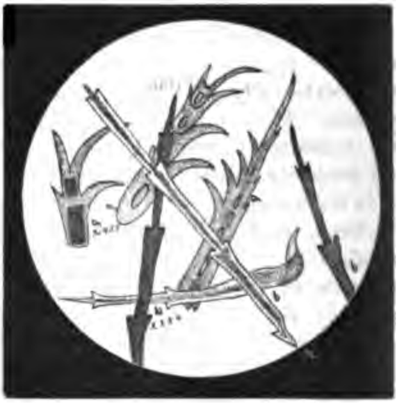

Fig. 5.—CONTENTS OF CYST REPRESENTED IN FIG. 4. *a*, *a*, *a*, Barbules. *b*, *b*, *b*, Barbs from downy portion of feathers.

The free barbs of the downy portions of the feathers, Fig. 5, *b*, *b*, *b*, were, of course, also undeveloped, yet parts cf the structure were quite distinct. In Fig. 6 is illustrated a portion of a barb from the vexillium. The central or medullary substance had gone on to a considerable degree of devel-

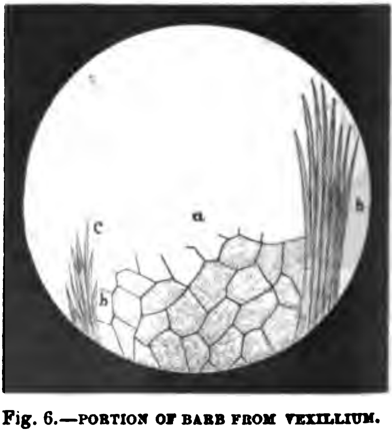

Fig. 6.—PORTION OF BARB FROM VEXILLIUM.

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*See remarks on cysts, Rohitansky's Path. Anat., Vol. III, p. 21.

opment, as is shown by the angularity of the cells.

The outer, or cortical layers, Fig. 6, *b*, *b*, were indistinct from arrest of growth and decomposition. So fragile were these portions that even the weight of the cover glass fretted out the broken ends, as seen in Fig. 6, *c*, *c*.

Of course feathery tumors are never found in the human body, but cysts containing hair, or other dermal appendages, have repeatedly been reported. True the greater number have been ovarian tumors,* yet hair has even been found in the brain of a human being,† and Rohitansky reports cases of hair upon mucous membrane and inner surfaces of incysted tumors.‡

Thus we have two more cases added to the great number of examples illustrating the similarity between the diseases of domestic animals and man.

But some one asks, "Why are wild animals free from disease? They are not. Wild animals are diseased, just in proportion to the extent that they are subjected to the peculiar circumstances which bring about certain results—those results being disease.

I once dissected a woodchuck (*Arctomys monax*) in which there were marked indications of inflammation about the omenteum. A great horned owl (*Bubo virginianus*) was brought to me some time ago, which had an unmistakable case of opacity of the cornea.

Parasites are common in the intestines of wild animals. Every sportman and every observer of nature knows that parasites are constant associates of all our common wild animals. So attached do these little fellows become to their giant friend, that often after his death they will congregate upon his cold form in clusters, resembling the pictures of heathens worshiping the sun; bow their heads to mourn the loss of their "own flesh and blood."

It is not because nature protects wild animals more than other animals that the former seem to escape disease, but because we have less opportunity to observe those animals not tamed or domesticated, when ill. And because we care little if they be diseased, as we suffer no direct loss, either physically or financially.

In a subsequent article, I hope to show the pathological structures of some growths from wild animals.

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*See Thomas on Diseases of Women, p. 658, or any other work treating of dermoid cysts.

†Rohitansky's Path. Anat , Vol. III, p. 250. Virchow's Cellular Path., p. 95.

‡Rohitansky's Path. Anat., Vol. III, p. 88.

◆

Isthmia Nervosa—A Study of Its Modes of Growth and Reproduction.*

BY J. D. COX.

Concluded from page 101.

7. *The Sliding of the Telescopic Hoops, and Formation of New Hoop Diaphragms.*—The growth of the diatom to a size sufficient to contain two full sized valves within the hoop, may or may not have occurred without the sliding of the tubes of the hoop upon each other. According to my observation, it depends upon the fact of the hoop of the parent diatom being broad enough at the time of its total separation from its parent, to equal the depth of two new valves.

In the stages of its history immediately following the appearance of the conjugate (or sporangial) frustule, as I shall notice presently, the hoop of the parent is narrow, the whole diatom being very broad in proportion to its length. Consequently the splitting of the hoop by intussusception, or the growth of new layers within, and the sliding of the tubes upon each other, accompany, in such cases, the growth of the cell contents, and may have to be repeated several times before room enough for the new valves is found. In other cases the parent diatom, having room enough within its girdle, the telescopic sliding does not begin till the new valves are formed, and the pair of young diatoms begin to crowd each other by their own growth.

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*An annoying typographical error occurs in the first part of this article, on page 101, first column, line 7. The word "nerve" should be "never."

What, then, is the process and method of this extension of minute draw tubes? I have already described the sutures which girdle the hoop at different places. The full-grown diatom seems to have its hoop also ripened into preparation for its new office. The separation of the lamellæ takes place, like the ripening of the shuck of a nut, which not only loosens it from the nut within, but prepares the seams between the segments to open at the slightest application of force. So the concentric films of the hoop, and the sutures crossing it, are prepared for separation when the growth of the cell contents demands more room. The weakest joint first yields to the strain, and the division goes on until the young plants are full grown and drop apart.

The simplest case is that of a diatom with a hoop wide enough for the formation of the new valves. Here the ripened hoop is at least double in thickness; the young diatoms press upon each other, and one thickness of the hoop separates from the other, at one end by a suture of the inside film, and at the other end by a suture of the outside film, and the two slide over each other till they slide apart. Many cases of this kind have been observed, in which the parts of the old hoop are persistent, and form the hoop of the new diatom. When the halves fall apart, the growth of the cell contents continues to force the valve out to the end of the hoop, or until the diatom is again ripened and has its growth. Then is witnessed a singular phenomenon. When the two valves are separated to the distance required for the division of the contents, and not till then, the first indications may be seen of the growth of a new hoop diaphragm, with its strong braces making the large horse-shoe areolæ. These also may be found in all stages, from the faintest trace and scarce visible outline, to the strongly marked and complete form. In one instance, not only were the faint outlines of the large areolæ seen, but through the whole interior of the hoop were traceable oval outlines partly compressed into hexagonal form, like a transverse section of a vegetable stem with closely packed oval cells. This is the only instance I have found of such indications of the beginning of the areolæ in a mere outline, but every slide I have is abundant in specimens, showing that when the inner film of the hoop is new and very thin, the areolæ are very much larger than on the exterior, often so much so as to reduce the connecting silica to quite narrow bands. Whilst the solitary example, therefore, will hardly warrant an induction from it, the statement as to the much larger size of the areolæ on new films is given as one fully proven.

Here, however, I must notice a fact which stumbled me. In the cases which I have noticed in paragraph 4, where the thick hoop has been found with a thinner part attached, and this last diminishing to a knife edge, the areolæ on the thin part have not been larger, but smaller if anything, as if split from the bottom of a depression corresponding to the outer areolae, (Fig. 2, *b*). After careful examination of numerous instances, including those in which the loosening at the suture is only partial, the best solution I can suggest is the following. These cases would seem to exist only when the separation has been forced, and premature, *i. e.* before the splitting of the hoop by intussusception is fully ripened. For in most cases of apparently natural growth, where the separation of the hoop takes place at one of these sutures, the doubling of the lamellæ on the loosened side extends all the way from the suture to the diaphragm, or to the next suture, and the sliding of the parts follows the usual appearance, the areolæ of the two films being similar in size. The weight of evidence seems to be that the doubling or tripling of the lamellæ occurs in both of the two methods indicated, viz., by the splitting of the exterior lamella, and by the rapid growth of a new one within, the latter case being the one in which the areolæ appear of very considerably greater size.

The telescoping of the hoops exhibits all the combinations which could be expected from the arrangement of sutures which have been described. The thick band commonly visible in the growing diatom may be caused by the simple lapping of two tubes, but it may also be caused by a real band, the division taking place at its two edges simultaneously, and the divided inner hoop sliding both ways out of the band, which is loosened, and falls when the separation is complete, giving one of the most common forms in which a perfect cast hoop is found, both margins being smooth and unbroken, (Fig. 3, *a*).

Before leaving this part of the subject, I will mention the fact that with high powers the areolæ on both valve and hoop can be seen to have a thin film of silica over or under them, the margin of each areola having an indented appearance, which I interpret to be little thickened projections from the thick margin upon the surface of this thin film, analogous to the braces or projections of the costæ upon the diaphragm of valve or hoop above described.

8. *The Conjugate or so-called Sporangial Frustule.*—For manifest reasons, it would appear to be improbable that much evidence on the subject of conjugation should be found in the dead remains of diatoms. But in this respect, as in many others, the indestructible character of the material has been the means of preserving testimony which presents itself unexpectedly, and is of decisive weight on one or two important questions.

I regard it proven by my observations that the so-called sporangial frustule in Isthmia propagates by division in the same manner as all the other frustules. It seems almost equally clear that from this large frustule its descendants decrease regularly in width, but gain in length, until the proportions are exactly reversed, the width of the conjugate frustule being equal to the length of that from which it sprung, at the moment of its full growth, and the consequent division of its cell contents, while its length, when leaving its shell, is only equal to the width of its attenuated parent.

The facts illustrating and supporting these positions are as follows: In carefully going over my slides of the dry diatoms on algæ *in situ*, I happened upon a specimen in which the end of a very wide but short frustule was still inserted in a small hoop and valve. The line of division between the valves of the large diatom was at right angles (or nearly so) to that of the small. Here was evidently a case of a chick with part of its shell still on its tail. Had the same been found in a cleaned specimen, it might have been accounted for by supposing the two accidentally to have fallen into such juxtaposition; but they were here as they had grown, and were the terminus of a filament which was plainly before my eyes. (Fig. 5, *b*). A hunt stimulated by this discovery, resulted in the finding of over a dozen more instances, all attached to the small parent frustule in a similar manner, but varying in their own length as they had progressed in growth, by the widening of the hoop. These being arranged in the order of their growth toward maturity and division, made a regular series, ending with two, one of which showed the faint outline of the nascent pair of new valves within the hoop, (Fig. 6, *a*), and the last was a completed example of division into two new frustules (Fig. 6, *b*). Later, among the cleaned but unmounted material was found an aborted frustule, in which conjugation had taken place, but the perfect growth of the valves had been stopped apparently by

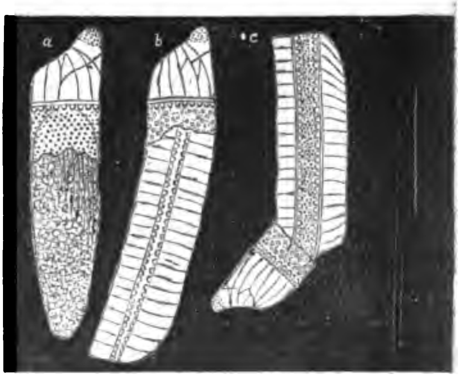

Fig. 5.

the breaking of the shell of the parent diatom too soon. As in the other cases, the end of the conjugate frustule was inserted into the parent shell, of which nearly half remained, and from which it projected straight out. Its coat was, of course, silicified, having withstood the boiling in acids, but its areolæ were confused and its shape imperfect, and no demarcation of valves distinguishable, (Fig. 5, *a*).

The relation of other filaments to these, among the specimens *in situ*, was such as to force the mind very powerfully toward the conclusion that the strings of large diatoms were those nearer in the degrees of descent to the conjugate frustule, and the strings of smaller ones were those further removed from the ancestor, but nearer to the advent of a new conjugation. In the presence of these facts it must require direct and positive evidence to support the theory that the conjugate frustule is a sporangium, giving rise to a numerous brood of new diatoms at once.

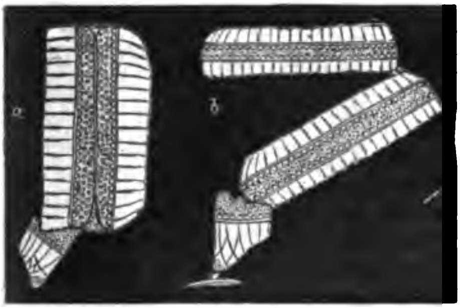

Fig. 6.

Whoever will take pains to compare the phenomena of the growth and division of Isthmia with the results of modern botanical investigations into the origin of the cell wall, its growth and division by intussusception, and the division of the cell contents, so as to form two or more "daughter cells," will, I am sure, be impressed with the evidence he will find that the general laws of vegetable physiology, as seen in larger plants, are as implicitly obeyed in these minute structures as anywhere in the vegetable kingdom.

We have only to bear in mind the fact, discovered early by Prof. Bailey, that cellular membrane may be demonstrated to coexist with the silica in the diatom walls, and the following general statement of Sach's in regard to the morphology of the cell, will be found to harmonise very perfectly with the phenomena I have attempted to describe: "The systems of striation and stratification of a cell wall, intersect one another, like the cleavage planes of a crystal splitting in three directions. But since the striations and laminæ consist of lamellæ of a measurable thickness, composed of alternately denser and less dense substance, the cell wall appears to be composed of parallelolipedal pieces, distinguished by their contents of water. If we for a moment disregard the stratification, and assume that we have two intersecting systems of striation, then where two denser striæ intersect, the densest or least watery places are always to be found; where two less dense ones intersect, the least dense or most watery; and where places of greater and less density intersect, areolæ of intermediate density are formed." ("Text-Book of Botany," Eng. Ed., p. 30.) The whole context of the passage quoted, the succeeding section on intussusception, and the treatment of the origin of the partition walls in tissue cells, which increase by bi-partition, in the same work (p. 72), describe the steps of growth in this diatom as perfectly as general statements can do. The specific peculiarity of the diatom is that the deposition of the silica in the membrane of the cell wall, so stiffens the parts as to make the separation of the lamellæ of the cell wall appear more like mineral cleavage, and has brought about the adaptation of the parts and of the natural forces to their peculiar work, so that the singular feature of the sliding of the hoops upon each other in mechanical fashion, has taken the place of the sort of accommodation which the softer parts of the common vegetable structure make for the growth of the new cells.

Many of the appearances of the diatom, at different stages of its growth, indicate a degree of plasticity and elasticity of the walls. especially in the case of the new forming valves, which very evidently yield to each other, crumpling the membrane more or less, before the silication has become strong, and presenting quite a different appearance from that of the strong and mature shell, which is finally exposed to the action of the outer water.

I have spoken of the gelatinous stipes as exuded from the sieve-like perforations of the lower end of the shell. This is, of course, an induction from the appearance of different examples of this stipes, and from the manner in which it is attached to other shells, or to the algæ on which the plant is found. It would be difficult to describe all these appearances, but a summary of them in one's own mind gives great strength to the conviction that the mode of growth is as stated. It is quite easy to understand how a similar exudation may give rise to the longer stipes of Gomphonema, Achnanthes, Licmophora, etc. It is only necessary to imagine the exudation more rapid, and rapidly solidifying on exposure to the surrounding water, to see how a long column may thus be built up. I, however, fully recognize the fact that scientific methods forbid that this should be regarded as anything more than a suggestion to be verified or disproved by actual observation of the life history of these plants, an investigation quite within reach, and which we may hope will stimulate the zeal of the members of the vigorous microscopical society of the Pacific coast, where these forms abound.

It is a little singular that the observed facts which have been detailed in the foregoing paper, tend strongly to support the earlier view of the character and office of the conjugate or sporangial frustule, as against the later one. As early as 1848, Mr. Thwaites, in the paper in the "Annals of Natural History," in which he made known his discovery of conjugation in certain species of diatoms, spoke of the occurrence of this phenomenon as "a mixture of Endochromes; after which process fissiparous division proceeds as before," and this view prevailed until arguments from analogy, but, so far as I know, without definite support from actual observation, led to the opinion that the conjugate frustule was in fact a sporangium. Dr. Carpenter has expressed this opinion in the last edition (1875) of his work on the "Microscope and its Revelations," saying (p. 817): "It has been already shown that the sporangial frustule, even when it precisely resembles its parent in form and marking, greatly exceeds it in size; and this excess seems to render it improbable that it should reproduce the race by ordinary self-division. Appearances have been observed which make it probable that the contents of each sporangial frustule break up into a brood of gonidia, and that it is from these that the new generation originates."

In like manner, Dr. Wallich, in the article to which reference has already been made, says, "The sporangial frustule, instead of being, as heretofore assumed, the primary or parent frustule of a new and vigorous generation, constitutes in reality the expiring phase in the life cycle of a generation that is passing away,"—that it is a "sporangial cell," "doomed, on the liberation of its living contents, to death and immediate decay."

The observations I have detailed appear to me a demonstration of the fact that the conjugate frustule *is* the "parent of a new and vigorous generation," and that the earlier belief is the better one. But whilst thus enforcing the danger of making negative assertions in matters of science, I will not fall into the same error by denying that there are among the diatomaceæ any sporangial cells producing broods of gonidia. The cases I have observed in *Isthmia nervosa* show that this diatom is propagated from the so-called sporangial frustule by ordinary self-division. I have looked with some care for evidence of distinct observation by others of the origin of any diatom from gonidia and have not lighted upon it.

In regard to the *Isthmieæ*, at least, Dr. Carpenter says the phenomena of conjugation "have not been clearly made out in this group." ("The Microscope and its Revelations," p. 314.)

Upon the topic of the mode of division of the hoop and the sliding of the laminæ upon each other, the same caution should be observed lest too large or too hasty conclusions are drawn from the facts. In regard to *Isthmia*, the cases observed seem conclusively to prove that the hoop proper is a permanent part of the diatom, except when the separation at the sutures is such as to leave a portion of the hoop free at both edges, in which event the separation of the young frustules drops this segment of the hoop. In other cases it remains attached to one or the other valve, and forms the outer coat of the wall of the new growing diatom. If we suppose that in any species no sutures occur in the hoop, except near the connection between hoop and valve, no cast hoops would be found, except when accident had broken the frustule, for the two lamellæ would adhere, one to the old and the other to the new valve, and this would satisfactorily answer the queries propounded by Dr. Carpenter in another passage, where he says, "In some other cases all trace of the hoop is lost, so that it may be questioned whether it has ever been properly silicified, and whether it does not become fused (as it were) into the gelatinous envelope."—*Id.*, p. 314.

The field is a most fascinating and an open one, and let us hope that careful observations will be pushed until the life history of all the diatomaceæ shall be thoroughly known, a work which the venerable authority just quoted well says, "may advantageously occupy the attention of many a microscopist who is at present devoting himself to the mere detection of differences, and to the multiplication of reputed species." It is also to be hoped that the valuable work already done in this direction by such able naturalists as Prof. H. L. Smith, and perhaps others, may be soon brought within the reach of all who are interested in these studies, so that the task of investigation may be lightened by avoiding unnecessary repetition of steps already taken, or by the encouragement of finding verification for observations which might otherwise be involved in doubt.

A Discussion of Angular Aperture.

BY ROMYN HITCHCOCK.

A Paper read before the New York Microscopical Society, May 17, 1878.

NO one who has followed the discussion of angular aperture, which occupied the pages of the London *Microscopical Journal* for a long time, will feel fully satisfied with the issue or the manner in which it was conducted. There is no doubt that much of the misunderstanding arose from a wilful disregard, on the part of certain ones, of the distinction between what we may properly call the true angular aperture and the angle of field. It is proposed to offer here a few remarks upon the whole subject, and invite microscopists of this country to consider the matter with care, to the end that we may forever put an end to any misunderstanding of what we mean by angular aperture on this side of the water.

The subject is a very simple one, and needs but little explanation, but there are many to whom the subject of "balsam angle" is a stumbling block. Unfortunately one cannot at present adopt a method of measuring the angle which will be entirely satisfactory, or at least one which all authorities will sanction. Under these circumstances the method used should be described in each case.

I shall not refer to the discussion in the journal mentioned, for fear of making this article too long, and will avoid argument as much as possible.

The original definition of the angular aperture of an objective, and the one which is now held by Mr. Wenham, and the majority of working microscopists, is the angle *a*, *b*, *c*, in Fig. 1. There are many reasons why we should adopt this angle, some of which will appear hereafter, and the following definition is therefore offered: *The an-*

gular aperture of a dry objective is measured by the angle at the apex of a triangle having a base equal to the available diameter of the front lens, and a height equal to the actual focal length measured in air, with collar adjusted for an uncovered object.

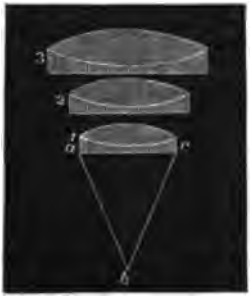

Fig. 1.

This is Mr. Wenham's definition, but not worded in the same language. Experience has shown that however plain the meaning may be, the least oversight in the wording will afford a welcome chance for misrepresentation, and a good instance of this will soon be given.

While we are pretty generally agreed as to the definition of aperture, it is a curious fact that the angle measured by the ordinary methods is not this angle, but a much larger one. In Fig. 2 this is plainly seen; *a*, *b*, *c*, is the true aperture, *b* is the focal point, but the field of view occupies the space *e*,*f*. Now if the aperture be measured by turning the objective until light ceases to enter it from the extreme angle, we find that instead of measuring *a*, *b*, *c*, we measure *a*, *d*, *c*, the light of the extreme edges of the field destroying the accuracy of the measures entirely. This angle, *a*, *d*, *c*, has been properly termed the angle of field, and we should insist upon this distinction in speaking on this subject. It is perhaps impossible to say how much this angle of field influences the defining or resolving power of an objective. There is no doubt it has much to do with it, and we should not hastily ignore it. It will very likely be found that the resolving power of an objective with oblique illumination will be somewhat better than theory would allow for the true angular aperture. Whether this power can be determined by considering the relation between the angular aperture and the angle of field, is a question not yet answered.

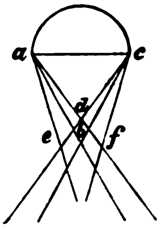

Fig. 2.

In experimenting upon objectives, we should know the true aperture under the conditions of use. But just here we are liable to go wrong. Suppose we have the true aperture as defined by our rule. This will do very well for a dry mounted object, but suppose our object is in balsam or a fluid—the case is totally changed, and we have what is known as the balsam angle to contend with, and the angle of light is changed materially. Still we are accustomed to speak of the aperture for dry objects all the same, which is manifestly wrong. To understand the effect of balsam, let us refer to Fig. 3. This figure represents a slip of glass having an index of refraction the same as Canada balsam. A cone of rays from below enters this slip, and suffers refraction in the well known manner, in consequence of which the angle of the inner cone is less than that of the outer. By applying the formula

$$\frac{\text{sin. outer angle}}{\text{sin. } x} = \text{index of refraction, we}$$

are able to determine the angle of the inner cone of rays in any medium.

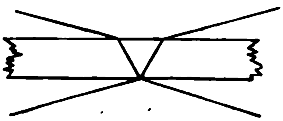

Fig. 3.

If we consider the slip to represent a slide with an object mounted in balsam, it is evident that whatever the angle of the illuminating pencil may be, the angle of the light which reaches the object, or which passes from the object through the balsam, is less.

If we calculate the extreme balsam angle, *i. e.* the angle obtained in balsam with a cone of rays in air as near 180° as possible, we find that the balsam angle is limited to about 82° at the very highest, for $\frac{\sin. 90^\circ}{\sin. x} = 1.525$ (index refrac.) and $1 \div 1.525 = \sin. 41^\circ 5'$, or about 83° aperture. The limit practically allowed is 82° for this angle. We are now prepared to understand the meaning of the absurdities that have crept into the writings of some microscopists who speak of apertures of 180° and plus 180°. As 82° is the limit for balsam, it corresponds with 180°, which is the limit for air. If now we can by any means increase this balsam angle to 84° or more, the corresponding air angle would certainly be over 180°, hence plus 180°. But how can this balsam angle be increased? There is but one way practicable, and this is by the use of some sort of immersion condenser below the stage, or a semicylinder with facets at the proper angle to receive the oblique rays perpendicularly to its surface, used in the manner mentioned by Mr. Tolles. By using such devices, the incident rays will pass into the balsam at any required angle, and the angle of emergence is only limited by the critical angle, or angle of total internal reflection, which for balsam is about 40° 30′. Now it is a fact that this whole matter of increasing the balsam angle over 82° by some device of this kind, has absolutely nothing to do with the objective, but some makers find in it a justification for selling glasses marked + 180°. Why, any objective might with equal propriety be marked in the same way. I say distinctly that the objective does not effect the balsam angle, which can only be increased by something beneath the stage which forms part of the illuminating apparatus, and no objective will enable us to use over 82° of balsam angle with simple illumination from the mirror. The advantages of increasing this balsam angle need not be discussed at this time. When the internal angle is 82° or more, the marginal rays will not enter any dry objective, for they will be thrown back into the balsam. However, by using an immersion glass, they may be utilized. What possible argument, then, can support the extreme angles marked upon objectives? We find that no one, not even the makers, claim to utilise an angle of 180° of light on a dry mounted object; the absurdity of such a claim would subject it to ridicule.

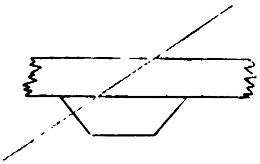

Fig. 4.

The claim is made on the ground of an increase of balsam or interior angle over 82°, the corresponding air angle of which would be over 180°; but we find that it is impossible for an objective to take up the light from a balsam mount when the interior angle is 82° or more, owing to the internal reflection of these marginal rays. That is to say, that no dry objective can possibly take in this excess, and therefore cannot have even an hypothetical aperture of 180°. We also find that no balsam object can possibly be illuminated with over 82° of internal angle without special illuminating apparatus. As for an immersion lens, the angle is always lessened by the interposition of fluid, and this question will not be considered here.

The upshot of the whole matter is, that these extreme angles are based entirely upon the false assumption that because the light may be caused to enter a balsam slide at an angle greater than 82°, therefore the objective should be marked to correspond.

Now, in order to avoid any misrepresentation of my views, I wish to say, that although an objective will not admit the marginal rays from an internal angle of 82°, or in fact does not, practically, admit many rays under this angle, it by no means follows that there is nothing gained by the increased obliquity of the illuminating pencil, for we know very well that the rays from an object which do not enter an objective frequently, have a great influence upon its appearance. In fact the angle of the illuminating pencil has perhaps quite as much to do with definition as anything else, whether all the rays enter the objective or not. In this discussion the influence of the slide and cover glass is disregarded. They will not materially affect the results.

I wish now to call your attention to an article of Mr. Tolles, which was recently sent me by Mr. Stodder. It was published in the Boston *Journal of Chemistry*, and entitled "On the Measurement of Air Angle." Although it was published in 1875, it is very likely new to many of the members, and as it is a curious production for a scientific article, I will read it entire, and then point out how the gentleman has misrepresented Mr. Wenham's views, as well as those of others who try to view this subject intelligently. We will now refer to the first quotation of Mr. Wenham's rule: "Mr. Wenham is unquestionably right in stating that if an isosceles triangle be described, the base of which is ten times the measured diameter of the front lens and the altitude ten times the measured distance of the focal point from the same surface, the vertical angle of that triangle will correctly represent the *maximum available* aperture."

Now, after speaking very properly of the limiting balsam angle of 82°, he goes on to say: "However, as this Brooke-Wenham rule of the triangle, by its terms and also from the nature of the proposition itself, applies for the measure of 'balsam' or interior angle exactly as for that of a dry mount or air-angle (of a certainty this will not be denied), therefore let us see how runs the application. Here are the data according to Mr. Wenham. Diameter of front lens, 0.043 of an inch. Focal distance in 'balsam' (through glass cover to the object in balsam), 0.018 of an inch. (*Monthly Micros. Jour.*, May, 1875, p. 225.) The objective as adjusted when measured for angle in London, as also here, was (by its construction) corrected for thickest cover, and therefore this focus of 0.018 is a *corrected* focus, and it follows that if the diameter is correctly given, the vertical angle of this triangle, derived from diameter and 'median height,' would be the measure of the angle in 'balsam,' viz., 88°. Thus, according to Mr. Brooke, Mr. Wenham's doctrine and measurements of the triangle combine to prove 88° of *balsam* angle in this very 1-6th objective. But 82° of balsam angle represents 180° of air angle, confessedly. *Thus, again, his own rule legitimately applied, according to Mr. President Brooke, establishes the fact of a maximum air-angle for the* 1-6th, which, as *measured* for angle by Mr. Wenham, was made to seem to have only 112°. Full angle proven and 'balsam' angle to spare,—six degrees surplusage!"*

Take the first paragraph. Mr. Tolles says "of a certainty this will not be denied." Now I say flatly that it will be denied, that the proposition, by its "terms" and "nature," justifies the assumptions of this paragraph, and Mr. Tolles knows very well, and knew at the time he wrote it, that it is a gross misrepresentation of Mr. Wenham's views. This is the plain English of it, and if Mr. Tolles or anybody else cares to question this very dogmatic assertion, he will have to show on what grounds he presumes Mr. Wenham to have been ignorant of the influence of cover glass and balsam upon the working distance of a lens. Why, the knowledge of it goes as far back as the time when Ross first made a collar adjustment, and there is absolutely nothing in the whole quotation from President Brooke's address which even intimates thet any medium was allowed between object and objective, such as Mr. Tolles assumes. Even admitting that, because Mr. Brookes did not deem it necessary to add a disclaimer of this balsam and cover glass, Mr. Tolles had a right to assume that the rule was applicable to balsam objects from the "terms" of the proposition, it seems hardly in place in a scientific discussion. It is well enough to criticize language that is not strictly expressive of its full intended meaning, but to base an argument upon such a flimsy pretext, and endeavor to misrepresent a man in this way, is more suited to a debating club than scientific writing.

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*Just at this stage of the paper, the Editor of this journal was kind enough to show me the copy of a forthcoming article of Prof. J. E. Smith, to which I will pay my respects later on.

To show how strictly true these assertions are, I will remind you that Mr. Wenham has always denied any of these claims of high balsam angles, as they are frequently represented, and yet Mr. Tolles uses the rule of Mr. Wenham to prove that this 1-6th has a balsam angle of 88°.

The second part of Mr. Tolles' article headed "How to use the surplus," would be an interesting subject for discussion, but it is absolutely impossible for me to give this part such consideration as I would wish, so it must be passed over in silence, much against my inclination; for while nothing in it justifies the use of the term plus 180°, in my opinion, the statements are in themselves interesting and instructive.

To make this subject complete, a reference to the aperture of immersion lenses is necessary, and here I think some very able microscopists in Europe have made great mistakes. It is a fact, strange as it may seem, that the apertures of immersion lenses have been measured just the same as dry lenses. When we consider that an immersion lens (I mean a lens corrected for immersion) used without fluid contact is worthless, we will at once see that whatever angle is measured without the fluid interposed is no indication of the aperture employed in actual working. Immersion apertures must be measured with the lens in the fluid employed with it, and we may properly apply the rule given for dry lenses, only substituting the word water for air.

I have now to notice the, as yet, unpublished article of Prof. Smith. I am glad of this opportunity to answer his questions, and only regret that I am forced to do so hastily. As the copy was only in my hands a few minutes, and was hastily read, it is not possible to take them in their sequence, and some may be everlooked entirely. I remember that he asks "What is 97° balsam?" Now, I believe that is already replied to in the body of this paper, but I recapitulate, and say that it is the angle at which light may be caused to enter balsam by the use of proper appliances below the stage, but that it will not enter an objective at such an angle, because it will suffer total reflection within the balsam, and therefore 97° is an angle which may be employed with any objective for illumination, since the objective has nothing to do with it, and it is wrong to mark the objective 97° balsam on this account. I am perfectly aware that such a statement will raise a storm in certain circles, but it will be observed that I refer to dry lenses, and depend upon the principles of optics for my opinion. I do not forget that it is claimed that some objectives show a bright field with light which seems to have passed through balsam at this angle, and this I do not pretend to explain or understand. If it is true—and now and then microscopists have been mistaken about their angles—I am inclined to think the angle of field may have something to do in the matter. At any rate I am prepared to accept the statement when any person shows that the critical angle of balsam or any other medium, is a fraud and delusion.

I learned something about the reflection of light when a school boy, and the principles have grown into my brain, so that Prof. Smith will find them hard to remove. Balsam angles in the nineties may *possibly* be employed with immersion lenses, and may be even useful with dry lenses, *as already stated.*

Prof. Smith justly says that Mr. Tolles knows more about objectives than either of us. I do not wish to dispute this, or to detract one particle from Mr. Tolles' abilities as an optician, and I am sure a man who does the excellent work he turns out deserves the respect of all microscopists. Nevertheless I do make a claim to a knowledge of elementary optics, and Mr. Tolles or any other man must not expect or claim to make an objective that will not conform to the laws of optics, or to have the support of scientific men in extravagant claims.

Now, my respects to the matter of "thorough physicists." I meant just exactly what I said, and it was perfectly correct. A physicist would never know from the expression plus 180° that this angle was one corresponding to an angle in balsam, and unless he happened to be practically familiar with the microscope, would very likely not know about balsam mounts. However, the intention was to convey the idea that the expression gives no clue to its origin or strict meaning, and therefore should hold no place in scientific literature.

Finally, I am astonished that Prof. Smith seems in this article to believe in an actual and practicable aperture of 180°. A more careful reading may make me change this view, but it is my impression from one reading.

Now, gentlemen, I am done. I have tried to express myself clearly, but have written in such haste that I have no time to-day to revise the article, so some allowance is due me if some things have been ambiguously stated. Preparations for leaving the city for a time have kept me very busy this week, and I have felt doubts about having this paper ready.

However, I stand up for optical law as applied to objectives, as to other things, and as to high balsam-angled lenses, I am open to conviction, but show me the man who will convince me.

Surely I do not wish to appear dogmatic, and am by no means conceited enough to believe myself master of the subject. There are many points not yet worked out in this connection, and it is not improbable that the angle of the rays which pass from the surface of the balsam to the objective should be carefully considered, as well as the angle of those within the balsam, when we consider the resolving power.

New York, May 17, 1878.

A New Cover Adjustment for Microscope Objectives.

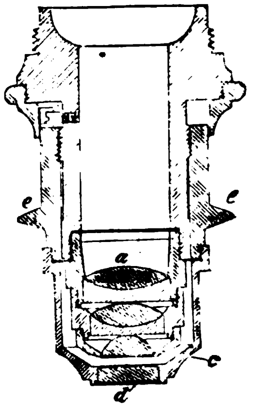
It is a well known fact among microscopists that the thin glass used to cover microscopic objects refracts the light so as to seriously disturb the microscopic image formed by the object-glass of the microscope.

The effect of the disturbance, caused by the interference of the cover refraction with the corrections of the abberrations of the object glass, is the greater and therefore the more annoying, the greater the magnifying power of such object-glass, and for this reason the more delicate must the adjustment for the corrections of the aberrations necessarily be. The present mode of overcoming this difficulty consists in mechanical means for increasing or diminishing the distance of the front lens of the object glass used from the other lenses composing the system. This method fulfills its purpose only within narrow limits, while beyond these, various secondary faults appear which seriously detoriate the performance of even otherwise most excellent objectives.

The cause of this imperfection lies in the circumstance that the change in the relative distance of the lenses composing the objective, by which the adjustment for cover thickness is at present sought to be effected, affects principally the chromatic aberrations, while the optical influence of the covering glass preponderatingly disturbs the correction of the spherical aberration. For instance, if both aberrations of an objective are corrected in the best manner for such rays as are reflected from an uncovered object, these rays will, as soon as the object is placed under a cover glass, suffer from a spherical over-correction, corresponding to the thickness of the covering glass—in other words, the rays passing through the peripheral parts of the object-glass intersect at a greater distance from the object than those passing through the central part of it, while the chromatic aberration is scarcely affected by it. In the adjustment for cover thickness at present, however, the relations of the aberrations are exactly the reverse, for by moving the front lens away from the other lenses of the system the object-glass will become more chromatically than spherically corrected. An object-glass, therefore, which has been properly corrected for medium cover thickness, for instance, can by means of this adjustment be adjusted so far only as to correct either the spherical aberration absolutely, and leave the chromatic aberration under-corrected, or, in the most favorable case, under-correct the chromatic aberration and over-correct the spherical aberration in such a way as to leave off both remnants of equal value. Besides this the distortions, spherical as well as chromatic are only at a minimum when the lenses are at a certain relative position to each other, and as in objectives of high angular aperture these defects can anyhow not be quite removed, the extreme position will so increase them as to make not only the distortion and color appearance at the margin of the field unpleasantly apparent, but to interfere seriously with the definition.

Furthermore, the changing of the relative distances of the lenses composing the object-glass seriously disturbs the focal relation of these lenses, causing a change in the magnifying powers of the object-glass which interferes seriously with micrometric measurements.

To obviate all the above mentioned difficulties, Mr. Gundlach has invented a new cover adjustment for object-glasses, in which he places before the front lens of the objective a transparent disk with parallel sides capable of being moved by some mechanical means closer to or further away from the front lens. The general mechanical construction or arrangement of the objective is shown very clearly in the accompanying engraving, which we copy from the patent office report. In the space intervening between this disk and the front lens he places a transparent fluid of a refracting power equal to or nearly equal to that of glass, affording thus, by increasing or diminishing the distance between the parallel disk in question and the front lens, and increasing or diminishing thereby the thickness of the layer of refracting fluid between them, a direct compensation for the increased or decreased glass cover of the object, and consequently of the aberrations, without disturbing the focal relations of the lenses of the object-glass, thus avoiding the increased distortions, and the disturbance of the magnifying powers of the objective consequent upon and inseparable from the disturbance of the focal relations of the lenses composing the system of the object-glass.



The advantages of this arrangement are obvious and we hereby summarize and recapitulate them; they are as follows: 1. The adjustment exerts no deleterious influence on the corrections of the aberrations and is equally as efficient for any thickness of the covering glass as for uncovered objects. 2. The working distance is the same for any cover thickness except for immersion objectives; for this reason objectives of very short working distance will with this adjustment admit of even the thickest covering glass. 3. The magnifying power is unchanged.

4. The image is placed but slightly out of focus by this adjustment. 5. The adjustment is very sensitive thereby facilitating the exact rectification. 6. It can very easily be so arranged that the graduations on the adjustment rim indicate exactly the thickness of the cover. 7. Any casual and unavoidable defect in the movement of the adjustment, has no influence on the centering of the objective, as any lateral displacement of the parallel disk causes no optical change whatever. The fluid between the front lens and the transparent parallel disk is glycerine, which has so far answered all expectations in a most satisfactory manner. Objectives made seven months ago have been sent long distances by rail without impairing their efficiency, and without loss or renewal of the glycerine. They might perhaps be used for years without the presence of any fluid being suspected. This new adjustment is applicable as well to immersion as to dry working objectives. It deserves to be mentioned, however, that for immersion objectives the advantages of equal working distances for every cover glass thickness do not exist. It is, however, the reverse of what it is with the old adjustment, as the working distance will be the further the thicker the covering glass happens to be. Mr. Gundlach has, we believe transferred the patent for this important improvement to the Bausch & Lomb Optical Company, of Rochester, N. Y.

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How Organisms are found in Clear Water.

IT was recently stated in a selected article in this journal that pure water contains nothing visible under the finest microscopes. This, however, is strictly true only as regards water that is chemically pure, and this definition does not apply even to the most carefully prepared distilled water. But in order that we may find such things in clear water, we are obliged to resort to peculiar methods.

It has long been known that the clearest water, in which no organized particles are to be found by the ordinary methods of examination, will, when added to an infusion in which all life has been destroyed by boiling, start the growth of fungi, such as certain forms of bacteria. The natural presumption in such a case would be that the water contained either germs or living organisms, and they might not be found by ordinary examination, because in such small numbers, in the large bulk of water. M. Pasteur has found that by allowing a cylinder of water several weeks to settle at an unchanging temperature, the contaminating particles sink, and the surface water is then incapable of causing life to appear in infusions. A constant temperature is here necessary to prevent any slight current in the water, which would result from heating and cooling.

Microscopical examination of the sediment thus obtained, showed the presence of living bacteria and spores of fungi, while in the upper portion of the water these were not to be found. It thus appears that living fungi may be found in almost all water by proper methods of examination, and these are capable of contaminating other suitable fluids and starting decomposition. H.

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Clothes-Moths, and How to Get Rid of Them.

Prof. C. V. Riley gives the following very interesting account of the clothes-moth, and indicates the best methods of killing them:

"The name clothes-moths is applied to several distinct but similar species of minute moths belonging to the family *Tineidæ*, which, in their larval state, are very destructive to woollen goods, fur, skins, feathers and similar substances. Among them may be mentioned the clothes-moth (*Tinea vestianella*), the carpet moth (*T. tapetzella*), the fur moth (*T. pellionella*), and the hair moth (*T. crinella*). These Tineidæ have slender bodies, and lanceolate, deeply-fringed wings that expand 6-10ths or 8-10ths of an inch. The antennæ and palpi are short and thread-like, and there is a thick orange or brown tuft on the forehead. The colors range from buff to drab and dark gray. The eggs are laid in May and June (the moth dying immediately afterwards), and hatch out in fifteen days. The young worms at once proceed to work, gnawing the substances within their reach, and covering themselves with the fragments, which they shape into hollow rolls and line with silk. These rolls are by some carried on their backs as they move along, and by others fastened to the substance they are feeding upon, and they are enlarged from time to time by additions to the open extremities, and by portions let into the sides, which are split open for this purpose. In such ambush the worms carry on their work of destruction through the summer; rest, in seeming torpor, during the winter, and change to chrysalids early in the spring. They transform again in twenty days, and issue from their shelter as winged moths, to fly about in the evening till they have paired and are ready to lay eggs. Then follows an invasion of dark closets, chests, and drawers, edges of carpets, folds of curtains, and hanging garments, and the foundation of a new colony is swiftly laid. The early days of June should herald vigorous and exterminating warfare against these subtle pests. Closets, wardrobes, all receptacles for clothing, should be emptied and laid open, their contents thoroughly exposed to light and air, and well brushed and shaken before being replaced. In old houses much infested with moths, all cracks in floors, wainscots, shelves, or furniture, should be brushed over with spirits of turpentine. Camphor or tobacco should be placed among all garments, furs, plumes, etc., when laid aside for the summer. To secure cloth linings of carriages from the attacks of moths, sponge them on both sides with a solution of corrosive sublimate of mercury in alcohol, made just strong enough not to leave a white mark on a black feather. Moths may be killed by fumigating the article containing them with tobacco or sulphur, or by putting it, if practicable, into an oven heated to about 150° Fah."

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To Prevent "Day Dreaming."—Study mathematics; engage in solving problems; bring your mind down to matters of fact; read works on natural history, on the natural sciences; give up romance, novels, etc.; try your hand at mechanism; invent and use machinery; finish what you begin, and you will cultivate application and prevent the mind from wandering.

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorised to receive subscriptions and advertisements:

Mr. Charles Stodder, 131 Devonshire Street, Boston.
S. E. Cassino, Naturalists' Agency, Salem, Mass.
J. G. Langguth, Optician, 88 State Street, Chicago, Ill.
James W. Queen & Co., 924 Chestnut St., Philadelphia.
W. H. Walmsley, 921 Chestnut Street, Philadelphia.
Fred. Wagner, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the American Journal of Microscopy. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Notice to Subscribers.

THE present number of the Journal will be sent to all old subscribers except those who have positively ordered a discontinuance. We hope that those who intend to subscribe for next year will remit as soon as possible. Those who order through our agents are, however, requested to make payment to them. It is fair to assume that those who do not remit before the issue of the next number do not want the Journal.

Microscopical Field Days.

THE New York Microscopical Society has adopted as a feature of their work, the system of *field days.* The members make excursions in company to different localities, and thus the younger and less experienced microscopists obtain not only a pleasant trip and unusual opportunities for making collections, but the guidance and instruction of the older members. The field days for 1878 are as follows: June 15, to West Point; June 21, Pelham, Barton Station; July 5, Keyport, N. J.; July 19, Bridgeport; Aug. 2, Jerome Station; Aug. 16, Newark Meadows, West-End Station; Aug. 30, New Dorp, S. I.; Sept. 13, Shrewsbury, N. J.

That these excursions will be productive of much pleasure and profit there can be no doubt, and the system deserves to be adopted by all our societiess. In England it forms a special feature of almost every society.

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The National Microscopical Congress.

WE are informed that the publication of the circular which is to contain the particulars of this meeting, will be delayed until July 12. Those who desire copies of the circular should address W. Webster Butterfield, M. D., Indianapolis, Ind.

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Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Microscopic Organisms in the Niagara River.

Ed. Am. Jour. Microscopy—It may be acceptable to your readers to see a few figures with regard to our great Niagara River, and the amount of water and microscopic organic matter passing down its course every day. I therefore take the liberty to send the following.

The width of the river in its narrowest part, near the waterworks in this city, is about 2,000 feet, and from measurements taken at different parts, the average depth is 17½ feet. The mean speed of the whole river is estimated at 6 miles an hour, or 528 feet per minute. Now, if we multiply the width by the depth and the speed, thus, 2,000 × 17½ × 528, we get as the result 18,480,000 cubic feet. There are 6.12 imperial gallons in a cubic foot. Therefore, we multiply 18,480,000 by 6.12, and obtain as the result 113,097,600 gallons passing down the river every minute.

A cotton strainer applied to a faucet of our water supply, retains a large amount of organic matter, varying in kind and quantity at different times of the year. Observation and some experiments, made through several years, show that it would be fair to estimate as much as 1 grain to 12 gallons of water. Prof. D. S. Kellicott, of the Buffalo State Normal School, found by actual measurement, in February last, 3½ grains of organic matter to a cubic foot of water. This was an exception to the general rule, as sometimes there would not be more than a fourth of that quantity. The estimate above given is rather under than over the actual average amount. Now there are 7,000 grains Troy to one pound avoirdupois. Then, if we divide the number of gallons of water, 113,097,600, by 12, and the quotient by 7,000, thus, 113,097,600 ÷ 12 ÷ 7,000, we obtain 1,346 pounds of organic matter passing down every minute, or 40 tons an hour, and 960 tons in a day.

The bulk of this matter is diatoms, and so the subject no less concerns the geologist than the microscopist. To me, sir, it would be very interesting to hear from other localities. Perhaps some of your readers will give facts and figures with regard to other rivers.

HENRY MILLS.

Buffalo, N. Y.

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High Powers with the Binocular.

[The following extract from a letter from Dr. Lester Curtis, of Chicago, Ill., will interest many of our readers:]

Ed. Am. Jour. Microscopy—I was a little surprised at an article in the March number about the use of the binocular with high powers. I have been accustomed for several years to use a Wales 4-10th of 100° on my binocular (Wenham's), with a Powell & Lealand's condenser, never finding any trouble in its use, or once thinking that every one could not do the same. I use this glass with the binocular a great deal in the study of anatomical preparations, and find great advantages in such use. Many structures which appear confused and indistinct with the single tube, are brilliantly sharp and well defined with the double tube.

Lately I have been using one of Gundlach's cheap 1-5ths in the same way, and find no difficulty in its use; though there is a slight shade around the edge of the field, not enough, however, to interfere with its definition. The 1-5th is not as good a glass as the 4-10th, consequently I do not use it as much.

I have not been able to use the binocular with the 1-10th. Lester Curtis, M. D.

Inquiry.

Ed. Am. Jour. Microscopy—Will you please tell me what I can make cells of, that Canada balsam will not penetrate when warm. I have made them of Brunswick black, gold size and Japan, and they will all spoil the object mounted. F. F. Shaw.

[Ans.—Canada balsam is a solution of a resin in turpentine, and as Brunswick black is soluble in turpentine, you cannot make of it cells that will resist Canada balsam. Paper is too porous. Gold size, when fresh, is soluble in turpentine, but when thoroughly oxidated and very dry it resists turpentine very well. The best cells would be metal or glass, cemented either with marine glue or some cement having a watery solvent.]

First and Second-Class Objectives.

Ed. Am. Jour. Microscopy—It was stated in this journal some time ago, by Prof. Hitchcock, that he would venture to say that "much of the very best class of work is being done with second-class lenses."

Now, although some seem to doubt this, I am afraid it is true, and for these reasons. Most writers on microscopy prefer and recommend narrow angles. Most of our opticians make their best objectives with the widest possible angles, while their second-class objectives have about the angles recommended by these writers, while their price is not much more than one-third that of the better class. Consequently they are generally used for working purposes. Nevertheless some of these second-class objectives are really excellent; as an example, I would refer to a recent 1-6th of 140°; it works both wet and dry simply by changing the adjustment, and cost only $25.00!

With this objective I have seen the dots on *Surirella gemma* by oblique white cloud illumination and 8-10 inch (C) ocular. In the hands of the makers it not only easily resolved *S. gemma*, but showed the lines on *Amphipleura pellucida!* With blue glass this feat was rendered "almost amusingly easy."

Allen Y. Moore.

Tulare, Cal., April 6, 1878.

Structure of Blood Corpuscles.

Ed. Am. Jour. Microscopy—It occurs to us, possibly some of your readers may not have noticed the recent demonstrations of Prof. Boettcher, of Dorpat, concerning the structure of the red blood corpuscles of mammalia.

His method in brief is as follows: Fifty parts by volume of alcohol of 96 per cent., saturated with corrosive sublimate, are poured on to one part of blood, being sure there is a rapid diffusion of the blood corpuscles in the fluid. The mixture is frequently agitated for twenty-four hours, when it is allowed to subside, and the superincumbent fluid poured off. The corpuscles will be *bleached*, "deprived of their coloring matter," and preserved.

Pure alcohol is now added, and mixture agitated for another twenty-four hours. After subsiding the alcohol is drawn off and water added. The corpuscles will now be colorless, or nearly so, and will remain unchanged in the water for an indefinite time. By using different staining reagents, the nucleus is brought to view.

Prof. Boettcher uses eosin, hæmatoxylin, picric acid and carmine, preferring the latter.

He describes three classes of corpuscles:

1. Blood corpuscles which appear shiny and homogeneous.
2. A homogeneous shining cortical layer, and a granular mass in the interior. The latter darkly stained by the carmine.
3. Corpuscles with a clear nucleus and a bright nucleolus.

By employing the above methods, the conclusions of Prof. Boettcher have been corroborated at this laboratory. Some five months ago we demonstrated to members of the Faculty a nucleus (rarely a nucleolus) in many of the red corpuscles of the dog, cat, rat and man. A 1-12th Wales and 1-15th Wale immersions were employed; powers from 900 to 1,800 diameters. The results will well repay the laborer.

We refer your readers to either of the following papers: "Archiv für Mic. Anatomie," Bd. 14. "Quarterly Journal Mic. Science," October, 1877, illustrated. "London Monthly Mic. Journal," November and December Nos., 1877.

C. H. Stowell, M. D.,
Physiological Laboratory, Univ. of Michigan.

Choice of Objectives.

Ed. Am. Jour. Microscopy- It was with real pleasure that I read the article entitled, "Dr. Carpenter on Angular Aperture," by W. G. Lapham, Esq., in your May issue.

First of all, it is very satisfactory, from the fact that Mr. Lapham speaks *from a practical standpoint.* The gentleman is an entire stranger to me, but the fact that his conclusions are drawn from his personal, and, I doubt not, protracted experience, is evident from the ability with which he handles his subject.

Your readers are well aware that I have often complained that I have been compelled to fight theory with practice, and that no effort on my part sufficed to induce my opponents to abandon their theoretical ideas, and to examine practically as to the truth of the positions advanced by myself. In Mr. Lapham, however, I recognize a co-worker, and although the results he arrives at are not in perfect coincidence with my own, I find nothing to criticize, but am simply desirous of further comparing notes with the gentleman, in the hope that something to the advantage of microscopy may be developed.

I propose to present a few thoughts for Mr. Lapham's consideration, requesting the gentleman to give them whatever study and attention he may elect, and to advise your readers as to the conclusions he arrives at; and, as before intimated, nothing that I have to say ought to be taken in the light of a criticism of his really excellent paper.

First, I desire to ask if Mr. Lapham does not attach too much importance to the so-called "penetration." Is there in *esse*, any such thing as "penetration?" Perhaps it will be well, first of all, to settle this point.

Now I hold as follows: We will take, for example, two glasses, both possessing the same amplifications and the same apertures; now of these two glasses, the one having the greater working distance will exhibit structures situated slightly out of the precise focal plane, or what amounts to the same thing, will be less susceptible to slight changes in the focal distance, or again, to use the words of Dr. Carpenter, will have the greater penetration. In extreme cases, the item of aperture may be disregarded. For instance, as stated in my Dunkirk lecture, a spectacle lens of 60 inches focal length will be endowed with greater penetration than a Tolles duplex objective.

But in the Dunkirk address, I did not avail myself fully of the demonstration afforded by the spectacle lens, but now invite Mr. Lapham's attention, thus: If it so be that with the spectacle lens I am enabled to see with perfect clearness of vision objects across the road, it will surely occur that when I attempt to read fine print, that the lens will defeat me. I will, to be sure, see the lines of the print, will recognize the contour of the book, and larger objects in immediate proximity, etc. Here is an example from everyday life, to wit: The glasses suitable for reading will not answer for observations at a distance. True it is that with such glasses, with which we read with ease, we may also see the general forms of things across the road, yet they suffice not to render clearly the *details* thereof. Hence we have all of us observed that many persons wearing convex glasses often use two pairs of spectacles, one for near and one for distant vision.

Now in this everyday case we are taught a lesson, that, from some cause or other, has been a slow one to acquire. First, "penetration," in its naked aspect, is simply a function depending upon working distance; and, secondly that "penetration," *unless accompanied with a certain amount of definition, is practically worthless.* I ask Mr. Lapham's close attention to this point, one that has been terribly overlooked.

Now, if Mr. Lapham's 1-6th of 180° happens to just "turn the corner," *i. e.* have balsam angle, say, about 85°, I would feel sure that a little observation would lead him to the same opinions I have arrived at, and I only fear that he has chosen one of the highest balsam angles, in which case he will have to fall back on his 4-10ths. Nevertheless, let him, if he will, try the experiment, and report as to whatever is gained in point of penetration by the use of his 1-4th of 50° over and above what can be obtained by the use of the 1-6th, or the 4-10ths. The point I have to make is this—the 1-4th of

50° will have the greater penetration (so called, like the spectacle lens) *but will lack definition*, to the end that more is lost in the latter element than is gained in the former.

I state as a matter of fact, but with no desire to bias the further observations of Mr. Lapham, that I have used just such a 1-4th as he describes, but have ultimately discarded it, and in favor of a 1-6th marked by the maker 180°, which I find will do all the work (penetration included) of the 1-4th of 50°, and a great deal more besides. But behind this 1-6th, I hold a 1-10th of 106° balsam angle in reserve, for work where "penetration" is ruled out.

As to the other point suggested. Is there not undue weight attached to this "penetration?" With me, I have often been obliged to take special measures to *get rid* of this function, and for this purpose use the Beck illuminator, which gives me only surface structures. I mention the fact, but am willing to admit that a certain amount of "penetration" is at times desirable, and should be provided for as perfectly as possible.

Mr. Lapham recommends a 4-10ths of 100°. I have often thought that such a glass, or a half-inch of the same angle, would be desirable, and, as a *luxury*, am still of the opinion. It must be remembered that he very properly rules out the item of cost; while on the other hand I have made it a study to avoid expense, where my opinion has been solicited in the matter of selection of objectives.

Mr. Lapham recommends a certain number of low-angled glasses, all others to be of the highest angles, and of the best quality and well corrected. Why not amend this by insisting that all glasses have the highest attainable angles? selecting of such the one suitable for the work in hand.

Again, Mr. Lapham states that we have no need to consider objectives of lower power than the half-inch for "they are not made with angles sufficiently high to injure penetration." Here is involved an error in fact, one quite pardonable too. Not long since a German gentleman remarked to the writer that it seemed to him that when the London opticians *demonstrated* a certain optical law, some Yankee optician would be just mean enough to make an objective that would upset the whole arrangement! And it is perforce of this *fact* that Mr. Lapham becomes involved in his very pardonable error. Now I have in my possession a 2-3ds of the Messrs. Spencers of 48° aperture. They have lately made to my order an inch of 47°. The clear diameter of both glasses is about the same; the working distance of the 2-3ds is 25-100ths of an inch, while that of the inch is but 13-100ths of an inch, and the "penetration" of the latter (so-called) is less than that of the 2-3ds. In fact the penetration of the inch is "injured," as compared with one of 30°. The reader will notice that Mr. Wenham's pet theory gets also into grief. I assure Mr. Lapham that this new inch is a glorious glass, penetration or no penetration.

Finally, I desire to extend to Mr. Lapham personally my thanks for his instructive and interesting article. It will be a pleasure, and, I doubt not, profit to compare notes with him, and, in the words of my very generous opponent, Prof. Hitchcock, I will add that all I desire is "the facts." Mr. Lapham, by the way, will be pretty sure to catch it, about that 180°, from Prof. H., on the "impossible" and the "absurd."

It may be well enough to add that my first impulse was to write Mr. Lapham privately for an interchange of personal experiences, but on reflection chose this, the more public plan, hoping to enlist the attention of others in the same direction.

J. Edwards Smith.

Homœopathic Hospital College, Cleveland, O.,
June, 1878.

Our Book Table.

Physics of the Infectious Diseases. Comprehending a Discussion of Certain Physical Phenomena in Connection with the Acute Infectious Diseases. By C. A. Logan, A. M., M. D. Chicago: Jansen, McClurg & Co.

This is not a very large book, and yet it would be impossible, in anything like the space at our command, to give a synopsis of the author's views and theories. To obtain a fair statement of these, the reader must examine the book itself. The work is largely taken up with a discussion of the influence of climatic conditions and physical phenomena on disease. Besides such ordinary subjects as the malarial character of certain grounds, the author gives his views on the influence of volcanos, earthquakes and similar terrestrial phenomena. The author spent, recently, four years upon the west coast of South America, in an official position, which afforded him exceptional facilities for study and research. This region is remarkably exempt from infectious diseases, and the author attributes this to its remarkable physical features, which he fully describes and discusses.

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TRANSACTIONS OF SOCIETIES.

Note.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of April 19, Mr. J. D. Hyatt, the president, in the chair.

A copy of the ninth annual report of the Microscopical Society of Liverpool was received, also the programme of the tenth session, 1878, with a letter from the Hon. Secretary of the society.

Hon. J. D. Cox, M. C. from Ohio, was elected an honorary member.

The corresponding Secretary reported some correspondence to the committee on postal laws, and read a letter from Dr. Blackham, of the Dunkirk Society, which included a copy of a letter written to Dr. Blackham by Hon. J. Patterson on the same subject.

The secretary read a letter from the Assistant Post Master at Washington, J. H. Marr Esq., in which he states that the Post Office Law Department had decided earth (diatomaceous) to be unmailable matter.

A letter was received from Mr. C. L. Peticolas, Richmond, Va., presenting to the society a series of slides of diatoms, collected in various parts of the country.

R. Hitchcock, Recording Secretary.

A regular meeting of the New York Microscopical Society was held on the evening of May 3, Mr. J. D. Hyatt, the president in the chair.

The Secretary read a letter from W. Webster Butterfield, M. D., of Indianapolis, Ind., asking the society to give its sanction to a National Microscopical Congress to be held in that city one week before the meeting of the American Association for the advancement of science at St. Louis. On motion, the invitation was accepted, and the secretary was requested to state that the society will be represented.

A donation of six slides was received from Dr. C. Seiler, as follows: Lung, tuberculosis, man; kidney, normal, child; tongue of cat injected; liver, cirrhosis, man; stomach, normal, frog; intestine, tubercular, man.

From G. I. Whitehead, leaves of silver tree from Cape of Good Hope.

Mr. F. Habirshaw was elected an active member, and Dr. A. Mead Edwards an associate member.

The Secretary read a paper on society work.

A committee was appointed to arrange excursions for field work during the coming summer.

R. Hitchcock, Recording Secretary.

A regular meeting was held on the evening of May 17, the president, Mr. J. D. Hyatt, in the chair.

The Secretary read a paper, "A Discussion of Angular Aperture," which called forth some discussion.

R. Hitchcock, Recording Secretary.

A regular meeting of this society was held on the evening of June 7, at No. 64 West Twenty-first street, President Hyatt in the chair. Dr. Frank M. Deems was appointed Secretary, *pro tem*, to serve during the absence of the Secretary. The minutes of the preceding meeting were read and approved.

A letter was read by the Corresponding Secretary from Dr. A. M. Edwards, thanking the society for his election as an associate member.

The Committee on Rooms reported progress. The Committee on Field Work reported a schedule of fortnightly appointments for the Summer, a printed copy of which was mailed to each member.

The paper of the evening was read by Prof. A. A. Julien, on "Recent Observations in Microscopic Lithology." Besides hand specimens, the subject was illustrated by numerous slides, beautifully mounted, to show the liquid cavities, or inclusions, in certain rocks and minerals. The thanks of the society were voted to Prof. Julien for his exceedingly interesting paper.

There being no other business, the meeting adjourned.

Frank M. Deems, M. D., Secretary *pro tem*.

A regular meeting of the New York Microscopical Society was held on the evening of June 21, at No. 64 West Twenty-first street, the President, Mr. J. D. Hyatt, in the chair. The minutes of the preceding meeting were read and approved.

The Committee on Field Work reported that they had mailed a copy of the field day appointments to each member of the Society. The committee was discharged with the thanks of the society. It was moved and carried that when the society adjourns, it adjourn to meet again the first Friday in September. After a general discussion of the subject of summer work, the meeting adjourned.

Frank M. Deems, M. D., Secretary *pro tem*.

State Microscopical Society of Illinois.—The regular meeting of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on Friday evening, May 28, 1878. President Henry W. Fuller in the chair. S. A. Briggs, a former President of the society and editor of "The Lens" during the time of its publication, but now residing in Florida, was present as a visitor. There were also many students present from "Rush Medical College" and from the "Woman's Medical College." After the ordinay routine of business, announcements of donations, etc., the President introduced Dr. I. N. Danforth, who read a paper on "The Circulation of the Nutrient Fluid in Animals and Plants." He commenced with the simplest forms, and by the aid of charts and well chosen language, clearly explained to his hearers the gradually increasing complex nature of the circulation way up through the mammalia. At the close of his remarks the audience availed themselves of the opportunity to see the subject of the paper in its living state. Drs. Danforth and Bellfield each showed the lung of a living frog; while on the society's stand and on that of Mr. B. W. Thomas was a frog with his tongue pinned out in good shape to illustrate Dr. Danforth's remarks.

Two other frogs waited patiently for a chance to exhibit the circulation in the webs of their feet, but as the supply of frog plates run short, they were obliged to content themselves with sitting still and thinking over the mutability of things batrachian.

Messrs. Summers and Prof. Bastin showed the circulation in chara, while Mr. Colgrove used nitella for the same purpose. Mr. Atwood had the larva of a large gnat, and Mr. Langguth showed some human blood. Prof. Bastin called attention to a slide he had prepared, being a section of the stomach of a frog; in the muscle was undoubted trichina; some members conversant with the appearance of the larva of the gordius were certain that it was not that, and there is no doubt but what it is the genuine trichina. A new portable stand made by Mr. Bulloch attracted considerable attention and favorable comment.

H. F. Atwood, Secretary.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, May 16, President Hyde in the chair. Many members were present, and gave their attention to three notable matters: First, a donation from Mr. C. Seiler, of Philadelphia, of six excellent pathological slides; second, a donation from Mr. Melville Attwood of 22 rock specimens, illustrating a new method of preparing the same for determination, and 24 slides of sections of these rocks; and third, a paper by Mr. Attwood, upon the microscopical characteristics of porphry. This paper we hope to give at length in a future number.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. Exchanges only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Slides of moss perestome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

For exchange, cluster cups on leaves of geranium, gooseberry and ranunculus. E. W. Holway, Decorah, Iowa.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Slides of the sugar mite, amœba diffluens, and foraminifera, in exchange for good material, or well mounted slides of interest. Clark M. Elliott, Auburn, N. Y.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

British plants and bird's eggs for American ditto. J. A. Sanford, 289 Summit street, Toledo, Ohio.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton elenthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of corn smut, spicules, and lepidopters scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 561, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, JULY, 1878. No. 7.

Trichinosis.

Paper read before the Calhoun County Medical Society, by Dr. D. C. Hauxhurst.

SINCE Prof. Zenker made his admirable researches in 1860, trichinosis has been frequently noted in many parts of this country and in Europe as an epidemic, proving fatal to many of its victims and seriously disabling many others. It was Prof. Zenker who so admirably described the symptomatology of this disease, and enabled us to place it in our nosological tables.

For many years it has been known that a certain microscopic parasite has its habitat in the muscle of the hog; but it had not been suspected that this parasite could live after having been taken into the human stomach. Prof. Zenker's discovery that the animals, on reaching the stomach, are dissolved out of their cysts by the gastric fluids, and that they pair and give birth to a numerous progeny, which make their way into the muscles, producing severe local lesions as well as serious general symptoms, came upon the medical profession almost in the character of a sensation.

In some cases epidemics of trichinosis were mistaken for cholera, and were treated for it; in other cases the disease was supposed to be typhoid fever. One author goes so far as to remark that trichinosis has been treated oftener as one of these diseases than as the trichina disease. Every year the number of such mistakes decreases, and there is at the present day no excuse for mistaking this serious disease for any other.

The pathology and symptomatology of trichinosis is so well given by Niemeyer, Flint and others, that I shall say nothing upon these topics. I design only to point out some of the most available methods of examining pork for the parasite.

If it be desired to ascertain if the flesh of an animal contain trichinæ, certain muscles should be examined first. The muscles about the loins and the diaphragm will present them in greatest numbers; next the intercostal muscles may be examined. They are often very numerous in the deltoid and in the muscles of the eye.

The worm penetrates the coats of the stomach and goes directly into the diaphragm. To the muscles of the loins it passes from the intestines by way of the mesentery. Having been observed in muscles at a considerable distance from its breeding ground in the stomach and intestines within a comparatively short period, as in the orbital muscles, it has been suggested that this parasite penetrates the coats of the blood vessels, and is swept into the most distant localities by the circulation. I know of no certain evidence that this is the case. When once within the muscle, which seems to be their normal habitat, the trichinæ make their way between the fibres and often travel long distances. Thus it happens that as they approach the tendinous attachments of the muscles, the converging channels between the fibres bring great numbers of them into a very limited space. For this reason, in examining a specimen of pork the extremities of the muscle should be chosen. I have often found from eight to twelve thousand in these situations in one cubic inch.

A first examination for trichinæ may be made with the naked eye. For many years certain punctate marks had been occasionally observed in the muscles in dissecting rooms, but their significance was not understood; they are the calcified cysts of the *trichina spiralis*. They are best observed, however, by means of a lens of slight magnifying power. There need be no preparation of the tissue, except to make a section and view it by ordinary direct light. On making the cut a certain grating sensation will be experienced, providing the cysts have been calcified. Trichinæ may exist in uncalcified cysts, or even free in the muscle; in which case this preliminary examination would be useless.

For a first examination under a microscope use a one-inch objective. Place a fine piece of the muscle in question on a glass slide in a drop of serum, or aqueous humor, or a one per cent solution of common salt. Teaze out the fibres and separate them from one another by means of fine needles set in sticks for handles; keep the eye all the while on the work, and watch for the dim outlines of the worm. Perhaps the cyst will appear first; it may be that your manipulations will have torn the cyst and let the worm out. A little dilute hydrochloric acid added when the cyst is once discovered will decalcify it and render the parasite visible through its translucent walls. When the tissue is well displayed by the above means, a thin glass cover should be placed over it; the focusing will be better and the parts more distinct. Judicious pressure on the cover glass may often be made to bring the trichinæ into view by thinning and displacing the parts under it. It is often an aid to use some staining fluid—Beale's carmine, or the hæmatoxylin fluid. I have often placed a drop of this fluid at the edge of the cover glass, watching the field while it made its way by capillary attraction among the fibres of the tissue, and have seen the outlines of the parasite come out clearly and distinctly when nothing could be seen before.

The examination by thin sections may be practiced with advantage. If the muscle be carefully dried, very beautiful sections may be made with a sharp razor dipped in dilute alcohol. These may be easily handled with a camel's hair pencil. The thinnest should be placed upon a slide under a cover glass, and may be examined directly in staining fluid or in the salt solution. Excellent sections may be cut from frozen tissue or from tissue soaked for a few weeks in strong alcohol, or in a ten per cent solution of bichromate of potash.

It is often of great advantage in searching for trichinæ to press the cover glass down with the point of a needle, forcing the staining fluid out from among the fibres of the section, and then to relax the pressure, thus permitting the fluid to return in numerous currents. Rapid alternations of pressure in this way will often wash away foreign matters and reveal the presence of the parasite. Sometimes it will be washed clear of the cyst, in which case its clear edges contrast sharply with the rich tints of the fluid. Occasionally a happy section will have been made in such manner as to reveal the trichinæ as soon as it is brought within the field of the instrument, and without manipulation. On the other hand, several sections will sometimes yield no specimen, even after most careful scrutiny.

In general, the first examination of a section will be made with a low power. If, on sweeping the eye over the field, any point of special interest presents itself, it may be examined with a higher power—a one-fourth inch objective, or a one-fifth inch.

Some of these sections may yield very beautiful displays of muscular fibre, and if put up permanently may be objects of great interest, as well for displaying the structure of the tissue as for the parasite contained in it. They may be treated with alcohol, and put up permanently in Canada balsam. Dammar lac, glycerine jelly, or even dilute glycerine, make very excellent preservative fluids for trichinæ.—*Detroit Lancet.*

The Presence of Elastic Fibres in Phthisical Expectoration.

SOKOLOWSKI and Greiff say (*Deutsche Med. Wochenschrift*, Feb. 9, 16 and 23, 1878,) that in many cases of phthisis, when the physical signs do not afford satisfactory evidence of destruction of lung-tissue, the demonstration of elastic fibres in the sputa becomes of great diagnostic and prognostic importance. The authors have made very numerous observations to determine how far the presence of elastic fibres in the sputa corresponds to the data of physical examination, in respect to the destruction of the pulmonary tissue. With this object they have followed the cases of seventy patients; the examinations for the fibres have been made by two methods, fresh and by Fenwick's process slightly modified, the latter being generally adopted,

They mixed the whole of the sputa with a soda solution (1 of liquor sodæ to 2 of distilled water) and boiled it for four or five minutes; then diluted it with an equal quantity of distilled water, poured it into a flat porcelain vessel, and fished out the particles suspended in the water, and subjected them to microscopic examination. In some cases they only found one single piece, in others many dozen; in the cases where so many were present, the physical examination also showed signs of great destruction of the lung, but in general no very great importance is to be attached to the number of the pieces. Their size varies as much as their number; in one case of gangrene of the lung the large pieces were more than a millimeter long; but in general they were only a few fractions of a millimeter. In color, the boiled fibres were yellowish-brown, or dark-brown and blackish. Generally the fibres assumed the structure of a reticulum, but very rarely as well marked as Fenwick figures it; the color is so distinct that artificial staining, as suggested by some (by fuchsin, as recommended by Duval,) is unnecessary. There are frequently fungus growths of sputa, which at first might be confounded with the fibres, but the greater thickness and regularity of the latter indicate their nature. (The authors here print a tabulated account of all their cases.)

Of the seventy patients who were examined, nineteen belonged to the stage of breaking down of the lungs with marked hectic; of these nineteen cases they found elastic fibres in eighteen; in two they found them only at the second or third attempt, although the physical signs of destruction were present. The single case, in which in spite of two examinations they failed to find any fibres, was a female patient, aged twenty, with great destruction of the left upper lobe and marked hectic; further investigations were made impossible by the departure of the patient. In another of the patients of this group they found fibres once only in several examinations. In one case the absence of the fibres corresponded to temporary improvement and freedom from fever; in another they found no fibres at their second examination, although no improvement, but an increase of hectic, existed. From their cases they conclude that, in cases of phthisis with demonstrable breaking down and decided hectic, fibres will be found, if not in one, at least after several examinations; but that in these cases the discovery is of no value, as the destruction of the lung-tissue is otherwise sufficiently proved.

Of eleven cases belonging to the category of chronic phthisis with unmistakable destruction of lung tissue, but without hectic, elastic fibres were found in all, but in one of these they were only found at the second or third examination, at a time when temporary fever and a relapse existed. Here also their discovery was of no diagnostic value. But may it be of prognostic value, as the case just referred to might indicate? In another case, in spite of general and local improvement (disappearance of the physical signs of a cavity), elastic fibres were found up to the time of his discharge, which served to show that, in spite of the apparent improvement, the destructive processes in the lungs were still going on.

In the other forty cases there were signs only of consolidation; the condition of all was good, and without fever, with two exceptions. In the first case, after a violent attack of pulmonary hemorrhage, diffuse pneumonia with high fever supervened, which terminated in death. In the second case, a feverish condition developed from time to time, which generally accompanied hæmoptysis. Of these forty patients sixteen had great consolidation of one or both lungs; of these sixteen they found elastic fibres in twelve cases; in four cases they found none. Of these four cases two had great consolidation of the right lower lobe; in the other two the consolidation was of very old date, and probably was already contracted. Of the twelve cases in which fibres were found, in one case they were discovered first at the second, in another not until the sixth examination; in the last patient their appearance was preceded by several days' fever and dyspnœa, probably indicating a commencing destruction of the infiltrated parts. In seventy-five per cent, therefore, of their cases of consolidation, they found these fibres present, which, they say, shows how frequently destruction is going on, although the physical signs are those of consolidation only. In such cases, the prognosis must always be made with caution. The remaining twenty-four patients had only very slight consolidation in one or both apices; in eight cases, or one-third of the whole number, the elastic fibres were found; in the other two-thirds there were none. Of these eight cases some are worth recording briefly.—*Cincinnati Medical News.*

The New "Oil Immersion" Object-Glass Constructed by Carl Zeiss, of Jena.

BY the courtesy of its manufacturer, this remarkable lens was sent me, a fortnight since, that I might carefully examine it. The results may be of interest to those who have not seen the lens, and the statement of them is due to the industry and skill of the maker.

The lens has a focal length of one-eighth of an inch; it is an immersion, but the fluid employed is the oil of cedar wood. The object of this is that the fluid placed between the lens and the covering glass of the object may have refractive and dispersive indices as nearly as possible coincident with those of crown glass, the material of which the covers and the front lens are composed. Ol. ligni cedri is the liquid that has been found to be most capable of meeting these conditions; and by its use the covering glass, thick or thin, and the oil and lens, become practically one homogeneous whole; and the need for the screw collar correction for different thicknesses of cover, is done away. At the same time, and by the same means, a large and efficient angle of aperture is secured. Mr. J. W. Stephenson, F. R. M. S., suggested to Prof. Abbe this method, and Prof. Abbe and Carl Zeiss have together produced the glass.

As a piece of workmanship it is extremely fine; and it can be used with quite as much ease as an ordinary immersion 1-4 inch objective. It works admirably with Powell & Lealand's ordinary sub-stage condenser, with Wenham's reflex illuminator, and with the small plano-convex lens which the maker sends with it to be fastened to the under surface of the slide with the oil of cedar wood. But I have also secured admirable results with the illuminating lens of Powell & Lealand's supplementary stage, which gives entire command over the angle of the illuminating ray.

The spherical aberration in this lens is beautifully corrected, the field being perfectly flat. The color corrections are, so far as the lens goes, equally perfect; but are somewhat conditioned by the dispersive power of the oil, which can be modified readily, and for which Carl Zeiss provides. The sharpness and brilliance of the definition which this lens yields is absolutely unsurpassed, in my experience; and it has a very great power of penetration.

I tested it with a series of tests with which I have proved and compared the glasses of various makers in England, the Continent, and America, for some years. Up to the time of receiving this lens, the 1-8 inch that had done the most in my hands, was one of the "new formula" lenses of Powell & Lealand. It is but justice to say that all my most crucial tests were equally mastered by the lens of Carl Zeiss. I have not been able to do more with it than with the English glass, *but the same results* can be accomplished *much more readily.* The correction has to be brought into operation, and careful adjustment made, to get the finest result with the English lens; but the German glass has simply to be brought into focus, and the best result is before the observer, provided that the light has been adjusted in the most efficient manner. It is true that for sharp and perfect definition we must be careful to adjust the length of the drawtube; in working this lens there is much need of attention to this matter; and speaking from a practical point of view, it takes the place, in securing crisp definition, of the screw-collar adjustment, although of course much easier of application. But it is so easy to work the lens with fine results on the more delicate tests, that I think that those who make the resolution of these their primary object in the possession of a microscope, can scarcely fail in securing their utmost desire. It is a glass pre-eminently suited for the resolution of difficult lined or beaded objects.

I have in my cabinet several frustules of *Navicula rhomboides* (*N. crasinnervis*) which I cannot fully resolve with Powell & Lealand's new formula 1-12 inch objective. But all that I *can* resolve with the English 1 8 I have resolved with the German glass. *Amphipleura pellucida* is easily resolved into delicate beads when the frustules are moderately coarse; and almost any that can be met with are resolvable into lines; and this when these diatoms are mounted in balsam. And the highest eye-pieces made may be used without any practical detriment to the image, although, of course, with a reduced sharpness of the definition.

On the whole, I think it in many senses the finest lens, of its power, that I have ever seen; and in every sense it is an admirable acquisition.

But it is a fact that even water immersion lenses are of very limited service in observations continuously conducted upon minute *living* organisms in fluid. We may gladly call in their aid in the determination of a delicate change of form, or in the more perfect detection and definition of an obscure point of structure; but for steady and constant work we are bound to avoid them, for the fluid under the delicate cover is in danger every moment of being "flooded," by coming into contact with the water on the top of the cover, and between it and the lens; because the movements of the organism have to be counteracted by the movements of the mechanical stage, in order to keep any form that may be studied in view constantly. But this opens to us the possibility of going to the edge of the cover at any moment; and thus, by the mingling of the fluids, rendering the observation void. This, of course, will apply still more fully when, as in the case of the valuable glass of Zeiss, the immersion fluid is an essential oil.

Happily, it is only in special cases that the greater analyzing power, combined with larger working distance, which is possessed by immersion lenses, is required. It is in the earlier study of an organism, and before continuous work upon it has begun. And even if it be not, in the majority of cases, a first-class dry English lens of a higher magnifying power, if efficiently used, accomplishes all that is required. Hence the fine "new formula" lenses, *dry*, (also provided with fronts to be used as immersion lenses), are as yet an unsurpassed boon for this special class of work. And certainly it is one which, in relation to biology, has a most important future. I know, of course, that the optician has irresistible limitations to deal with; but the "new formula" dry lenses I have referred to, prove, in comparison with the preceding lenses made by the same firm, that the dry lens was capable of most serviceable improvement. The same applies to a 1-35th inch lens, made recently at my request by the same skilful makers. As an analytical optical instrument, it is possessed of capacities far greater than are represented by its mere increase of magnifying power over the 1-25th inch objective by the same makers, and equally so in relation to their 1-50ths of six or seven years ago, when the superior magnifying power of the latter is considered. And yet the 1-25th inch and the 1-50th inch to which I refer, were admirable glasses, and have done excellent service. What is important, therefore, is that the larger demand for lenses that will resolve readily difficult lined and beaded objects, which can certainly be best done, all things being equal, with immersion lenses; and to the improved manufacture of which Carl Zeiss' oil immersion gives apparently a new departure, should not lead the best opticians in England, the Continent, and America, to abandon efforts for the still greater improvement of their dry lenses. They are of the greatest value to the practical biologist, working amidst the minutest living things in nature, and from the study of which so much may be anticipated.

There is another feature in the use of this lens which is a drawback. The essential oil is a solvent of most of the varnishes and gums used in mounting and finishing microscopical slides, and consequently some of our cherished tests—placed near the edge of the cover, and which we have been in the habit of using for years, will not serve us. And this, of course, has a wider application. But this may be overcome by coating the edge with shellac varnish, which the oil does not dissolve; only this is extremely brittle, and is not to be depended on. But it is further necessary, in using this lens, that the objects should be mounted in balsam, or some other fluid with an equal refractive index. The majority of dry mounted objects are by no means better shown by this lens than by an ordinary immersion lens. But this may be overcome if the objects, such as frustules of diatoms, be "burnt" on to the cover. This intimately unites the crown glass cover and the object, making them practically one. If this be not done, the ray coming from the object has to enter air before passing into the lens, so neutralizing the special properties of the glass. But here again the *special* objects—used, for example, as tests—and obtained as the result of years of careful selection, are of no avail.

But this glass will be of great value in the study of rock structures, etc., because the oil will render them transparent without special polishing; and its great working distance will, in such work, be a great boon.

It may perhaps be right to note that this lens, although not provided with the complex arrangement of "screw-collar adjustment," and although *only* "immersion," is higher in price than the most costly 1-8th by any English maker, although the latter lens may have the screw-collar correction, and be both immersion and dry.

W. H. Dallinger.

St. James' Parsonage, Woolton, Liverpool, May 1.

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Canada Balsam Microscopes.

THE article on penny microscopes in the first number of this journal was quite interesting to me, recalling to mind the balsam lenses I have made in times past. Of course these cheap lenses can not be used for scientific purposes, nor their performance be depended on for accurate work, nevertheless they may be made very instructive and entertaining, and with a good book, such as Rev. Wood's "Common

Objects of the Microscope," or Lankester's "Half Hours with the Microscope," almost any person can learn enough to pay for the trouble of making the microscope and the money expended for the book.

About two years ago—it was before the summer of 1876—I made and experimented with some of these balsam lenses. I found it difficult to make a lower power than twenty diameters, with good definition, but the higher powers were much more easily made and gave far better results, but they had a very short working distance and were hard to use on that account. I used a pill box with a hole in both bottom and cover. Over the bottom (outside) was a thin piece of mica; on this mica, inside of the box, was a very small drop of balsam. For a diaphragm I used a piece of black tissue paper with a pin hole in it; this was gummed on the outside of the mica—the hole coming under the lens—and the edges turned down around the box, which was then covered with gilt paper. It then presented a very neat appearance.

The highest power I ever made, was 300 diameters, and it had working distance enough to use No. 1 covers. I used to take considerable pleasure in "fighting" these balsam microscopes against cheap non-achromatic compound microscopes, such as Queen's and McAllister's "Household" etc. The balsam lenses would usually beat!

This morning I came across a box containing four of these balsam microscopes, among them was the one magnifying three hundred diameters. I took a slide of *Stauroneis Phœnicenteron* from my cabinet, and was surprised to see how plainly I could see them. I got a glimpse of the lines but they did not show very plainly until I moved my hand so that sunlight could strike them, when, to my surprise, I saw them clearly and beautifully resolved. These lines number about 34,000 to an inch.

So much for balsam lenses. If any of the readers of this journal experiment in this direction, I should be pleased to hear what success they have.—*Allen Y. Moore in Young Scientist.*

On Preparing and Mounting Leaves and Other Parts of Plants to Show the Crystals in Situ.

BY W. H. HAMMOND,

EVER since I first began to use the microscope, plant crystals have been objects of interest to me, not only on account of their great beauty as "objects," especially with the polariscope, but also because they open a new and comparatively unexplored region of phytotomy; in fact, except in Professor Gulliver's writings, they are hardly mentioned, or very summarily dealt with by other botanical writers. At first I used to be content with a sight of them after boiling and mashing parts of plants, but I soon became dissatisfied with this method, and began to look about for some means of examining the crystals just as they grew in the different plants; fortunately I happened to look at a back number of *Science Gossip* (January, 1875,) and came across a paper by the late Dr. Beatty, "On Decoloring and Staining Vegetable Tissues for Microscopic Examination;" other papers, by Dr. Beatty, came out afterwards, and I gathered many valuable hints from them on the subject.

I am often asked how my preparations are made, so I will describe my process of preparing and mounting, for the benefit of other workers with the microscope, who are interested in these beautiful, but much neglected, marvels.

The first thing to be done is to get the bleaching solution, and this may be very easily prepared as follows :—Equal weights (say four ounces) of chlorinated lime and common washing soda, both in fine powder, are put in a half-gallon bottle of cold water, and well shaken together, then left to stand till the fluid is quite clear; this is poured off gently into another bottle, and a strong solution of washing soda added as long as a white powder is thrown down. The mixture is again left till clear, and then poured off; this is the bleaching fluid. The original substances in the first bottle may be again treated with cold water. Leaves and other tissues are kept in this fluid till bleached and semi-transparent; large or thick leaves should be cut up into small pieces. I find the small, round night-light glasses, which may be bought for a penny each, are very convenient for bleaching the tissues in, and also for the dyeing and subsequent soakings, covering them over with pieces of glass to keep out the dust. It is not always convenient to prepare and mount leaves directly they are gathered, so I always carry with me a small account-book, interleaved with blotting paper, and with an elastic band round it; leaves are put into this when gathered, and by carrying it in the breast-pocket of the coat, they are soon dried by the warmth of the body; in the summer time several books full of leaves are collected, ready for the long winter evenings. Dried leaves will bleach sooner than fresh gathered ones.

Having bleached some leaves (the time it takes to do this varying much), they must be well washed in warm water in basins or pie-dishes, changing the water often for about two days, and brushing the tissues with soft camel-hair brushes. I often find it of use to put the plant tissues into acetic acid and water for about a minute before the final washing, but acids must be very cautiously used, or the crystals may be dissolved.

The leaves or tissues are then ready to go into either of the following dyes:—

The carmine dye is prepared partly according to Dr. Beales's formula, viz: Carmine, 20 grains; strong liquor ammoniæ, ½ dram; pure water, 4 ounces.

The carmine is heated in a test tube with the ammonia till dissolved, and then added to the water in a bottle and well shaken, and left to settle or be filtered. The dye should smell strongly ammoniacal. Sections are soon dyed in the above, but leaves take several days, or a week or more. Sections of the India-rubber plant leaf, or of the common fig, dyed in carmine, will show the stalked crystals, called cystoliths, very nicely; pieces of the leaves of the fig, hop, nettle, wall-pellitory, or wych elm, dyed, will show the cystoliths when viewed from above or below. I generally mount two leaves or pieces on the same slide, one with the superior and one with the inferior surface uppermost.

The logwood dye is prepared according to the prescription in Rutherford's "Histology."

A. Make a saturated solution of calcium chloride in 70 per cent alcohol, and then add alum to saturation.

B. A saturated solution of alum in 70 per cent alcohol.

C. Add A to B in the proportion of one to eight.

D. A barely alkaline saturated solution of logwood in water.

Add D to C till a deep violet-colored dye is obtained.

I make D by boiling logwood chips with water and a very little potash; then filtering.

I generally use methylated spirit where alcohol is recommended.

The leaves and tissues may be immersed in either of the above dyes, straight from the last wash-water, and will be dyed in either in about the same time. Tissues when dyed must be put into clean water, then, if dyed with carmine, into acetic acid and water for a minute; if dyed with logwood they must be put into alum and water, they must then be put into two changes of clean water and brushed with soft brushes. The remaining operations will be described further on.

I also use a blue dye made by pouring six or eight drops of Judson's aniline blue into an ounce of methylated spirit, shaking and filtering. Leaves and sections to be dyed in this must be soaked in methylated spirit for about a day after being taken out of the last wash-water. After dyeing they must be washed and brushed in methylated spirit. Leaves generally require to be kept in this dye for about a week. Leaves and sections after undergoing these operations may either be mounted in Deane's gelatine medium, or in dammar or balsam dissolved in benzole. I like to have specimens of the same kind of leaves dyed in all three colors and mounted both ways, or only the blue-dyed ones mounted in balsam or dammar.

Leaves or sections, which are to be mounted in Deane's medium, should, after the final washing, after dyeing, be put into the following solution as recommended by Mr. Deane, for two days: Rectified spirit, 1½ ounces; pure water, 1½ ounces; pure glycerine, 5 drams.

Take the tissues out of the above fluid, drain off as much as possible and mount in the medium. I prefer this way of mounting for most leaves and other tissues, for this reason, it does not make them so very transparent as dammar or balsam does, and generally every cell-wall is distinctly seen, the crystals in the cells, the hairs, and every other part of the leaf.

Leaves to be mounted in dammar or balsam should be thoroughly dried from the last washing, after dyeing; this is best done by putting them into one of the before-mentioned interleaved books, and carrying in the pocket for a day or two. When thoroughly dry take them out and put them into a small wide-mouthed bottle, pour over them benzine enough to cover them, and cork up tightly till perfectly transparent. When ready to mount, take the leaves out of the benzine, drain, but do not dry them, and mount quickly in balsam or dammar dissolved in benzine (benzine collas is the best benzine to use). Leaves mounted in this way are beautiful objects for the micro-polariscope, if they contain crystals or have hairs upon them, but they are nearly always so transparent that the cell-walls are quite obliterated.

Good leaves to experiment upon, for sphæraphides, are chickweed, mercury, wild strawberry, and many of the rosaceæ.

For long crystal prisms—the outer skin of the gladiolus bulb, onion, shalot, and garlic.

For short prismatic crystals—Clover, sanfoin, beech, and trefoil.

For true raphides—Squill bulb, hyacinth, blue bell, lemna trisulca, balsams, willow herbs, fuchsias, and arums.

Cystoliths. — Leaves containing these should not be mounted in balsam or dammar, as they do not polarize, and are generally rendered quite invisible by this way of mounting.

No one need be afraid of not being able to procure specimens, for I believe the greater part of our plants contain crystals of one kind or other; they may be well and easily studied by mounting in Deane's medium after preparing and dyeing; they may also often be very well seen by simply bleaching, washing, and examining in water. And I may add that the crystals afford an abundance of beautiful materials for the microscope, and that the more they are studied the more they will be admired. Their taxonomic and physiological significance, too, is an important subject for further research, concerning which, Professor Gulliver has given the results of extensive observations. He recommends boiling the plant tissues in a solution of caustic potash; this is an easy way of exposing some crystals and their cells, though by no means so effectual in the preparation of beautiful and instructive slides, as the methods which I have attempted to describe.—*Science Gossip.*

How to Make an Aquarium of Microscopic Objects.

TAKE with you a small tin pail down to the seaside, and fill it full of pure salt water. Walk along on the sunny side of some creek or inlet, until you come to a spot where eel-grass or sea-weed is growing luxuriantly. Place your pail of water down beside you, and in it wash carefully a quantity of the eel-grass or sea-weed. Repeat this operation several times at different places, being careful not to soil the water with mud. Now put into your pail a pebble with a choice bit of sea-weed attached to it, and you have all the material necessary for your aquarium. Take it home, and pour the water into a small glass phial, drop carefully into it the stone with the seaseed growing upon it; then, after covering the mouth of the bottle with muslin to exclude dust, place it in a sunny window, and in a few weeks you will be astonished at the result. The sea-weed will have shot out little delicate branches through the water, which will remain perfectly pure and transparent for months, while every drop of it will contain many living objects of different varieties that will increase and multiply to a wonderful extent, and will be ready at all times to be admired under the microscope.

As the water in the phial evaporates, it will be necessary to add fresh to it. By adding salt water, it is evident the whole would soon become too salt to sustain life. *Young Scientist.*

Wide-Angled Objectives for Purposes of Natural History.

THE following letter from Dr. Dallinger has been frequently referred to by writers on microscopy, and it contains so much valuable information, bearing directly on a subject which is at present deservedly attracting a great deal of attention, that we feel compelled to give it a prominent place in the journal. Dr. Dallinger's observations on the life history of the monads, carried out in conjunction with Mr. Drysdale, are acknowledged on all hands to be models of thorough microscopical work. Under these circumstances our readers will forgive any merely personal matters which may be contained in the letter. It is proper to add that we have Dr. Dallinger's direct permission to publish it:

LIVERPOOL, June 22, 1876.

I have been unexpectedly delayed in completing the statement of my opinion of the Tolles 1-4 and 1·8 object glasses, and hasten to do so now.

At the outset, I have no hesitation in placing them amongst the very finest glasses produced up to this time. I have had, during the past 3 or 4 years, a large number of lenses, of English, Continental and *American*, in my hands for examination and comparison. Only, in my judgment, a small proportion of them *approach* the standard reached by the lenses in question.

The following summary of the details may be of interest to you.

I did not make the critical examination of the angle of aperture in Tolles' lenses, but from rough observation they were quite equal in this respect to the 1-4 and 1·8 of Powell & Lealand, made on their new formula in 1875. I therefore determined that all comparisons of results should be between these pairs of glasses respectively; and I do not hesitate to say that as high-angled glasses, the two English ones had hitherto surpassed any others with which I compared them.

The list of objects I employed were the careful selection of many years. They had been constantly used for the same purpose, and consequently no doubt existed as to the result in any case to be expected.

The chromatic corrections of the American lenses I found to be as perfect as could be desired, but the corrections for spherical aberration were not as good as in the P. & L. lenses, and consequently when the 5th and 6th eye-pieces of P. & L.'s series were used, the results with Tolles' glasses were not as good, and this was the same whether the illumination and general arrangements remained the same for both glasses of the same power respectively, or whether all the arrangements were especially made for each glass separately.

But, having said so much, I have, except in one special matter, little else to say as to the difference between these sets of lenses.

The results, in daylight, without the use of any sub-stage apparatus, save the mirror or prism, were identical. A very fine *Nav. rhomboides*, which had *resisted every glass except one of P. & L.s finest* 1-16*th objectives*, until I received their new 1-8th, was resolved with equal ease and perfection by both the English and American 1-8ths, but the area of the frustule resolved was slightly larger in the former. A slightly coarser *N. rhomboides* was resolved in the same way by the two 1-4ths. The results were absolutely undistinguishable.

With P. & L.'s sub-stage condenser and lamplight, the results were equally satisfactory. An extremely fine form of *N. rhomboides*, a selection indeed of the finest and most difficult set of German and English slides, *labeled Frustulia Saxonica*, was resolved and *defined* in the most perfect and brilliant manner by the Tolles 1-8th and the first eye-piece and on to the fourth, but the deportment of the English glass, which could not have been distinguished from the American up to this time, showed a decided advantage with the fifth and sixth eye-pieces.

By the same means both 1-4ths resolved the *N. rhomboides* (used with the 1-8th by daylight) perfectly, and the definition was as brilliant up to the fourth eye-piece with one glass as the other; after this, with the fifth and sixth eye-pieces, the advantage was slightly with the English glass.

I used Wenham's new illuminator, as you wished. The results were extremely good, but I found in this, as in many preceding instances, that they were not equal to the finest I could get with the Powell & Lealand condenser. But they were alike for both sets of lenses.

I brought out the powers of the Tolles lenses best with the "supplementary stage" illumination of P. & L. A still finer *N. rhomboides* in *balsam*—the very finest I have ever seen, of a German set *labeled F. Saxonica*—which always tried my new P. & L. 1-8th to the utmost, was resolved with no disadvantage to the Tolles lens, only not so large an area of the frustule was clearly defined as with the former. As *this F. Saxonica* is more difficult to resolve than any *A. pellucida* I have been able to procure, I need not say that this form was also resolved with, I think, equal perfection by both the English and American 1-8ths.

By the same illumination and the fourth eye-piece, the transverse striæ of *A. pellucida* was beautifully shown with both 1-8ths.

I had yet in reserve one test for the 1-8th; it was the presence of the flagella in *Bacterium tercus*. It is necessary to reduce the refractive index of the fluid in which they are, to properly and with moderate facility detect these delicate organs. Having done this, I first employed Wenham's illuminator. Now if the light be well managed, and all the corrections be made in the most delicate way, it is quite possible and even easy for a good observer to see the vortications at the end of the *bacteria while they are in motion*, but it is only in the *still* or nearly still forms which nevertheless keep up a sluggish lashing of the flagella, that the *flagella themselves* can be seen. It is quite possible in comparatively transient observations to take vortication for the flagella; but my colleague and myself had long been familiar with this; and this led to determined effort to see the flagella in a still or almost still condition, which, as you know, we eventually did.

Now, the *vortication* was beautifully seen with the Tolles 1-8th and the Wenham illuminator, but I could not by any effort, even in the still and nearly still forms, satisfy myself of the presence of the actual flagella; as it was with the supplementary stage illumination of the P. & L. that we had found these flagella; I now employed it again with the English 1-8th; after the usual care and the concurrence of the required conditions, I saw the flagella at both ends of a sluggish form lying in the centre of the field as perfectly as I saw the body of the *bacterium itself*. There was just enough vitality in the object to keep the flagella in gentle motion, but the body of the bacterium was still.

I now carefully removed the P. & L. 1-8th, and put on the Tolles, and with very little effort the flagella were beautifully seen, but not for the whole length as clearly defined as with the English glass; to be sure that this was not due to fortuitous conditions, I again put on the P. & L. glass, securing the former result, and then tried the Tolles with precisely the same issue as in the first comparison. The difference was slight, but there was a difference, the more clear to me from the nature of the image usually presented by the English glass, to which I had become comparatively accustomed.

I cannot *imagine a severer test* than this for any glass; and the deportment of Tolles' glass in working upon it is to my mind a guarantee of its high excellence, for although I have used every objective up to the 1-50th, I have never seen it (the flagella) with any but the P. & L. 1-8th, and this one of Tolles of the same power.

You asked an unbiassed opinion; you see that I have given it, and I am sure I need not say purely from scientific motives. Believe me, dear Sir,

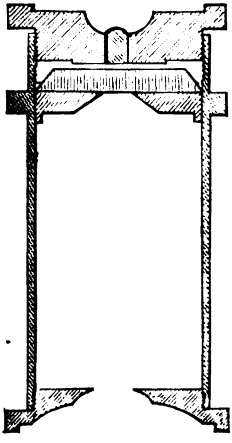
Most truly yours,
W. H. Dallinger.

To C. Stodder, Esq.

A Collecting Microscope.

THINKING that anything new in the way of microscopes may interest the readers of this journal. I send you a sectional cut (full size) of an immersion collecting microscope, recently made for me by the Spencers, of Geneva, N. Y.

I have found it quite valuable when after desmids, diatoms, etc., as it is a compressorium and animalcule cage, as well as a microscope of seventy-five diameters. The metal part is of well finished brass.



When the mounting of the lens is screwed down as far as it will go, the front surface of the lens comes in contact with the thick glass stage. This latter is beveled around the edge, similar to a first-class animalcule cage, and when the screw is slightly oiled, objects in fluid may be kept for a long time, as it is then air-tight, and evaporation prevented. The focus of the lens is at its plane surface.

The drawing makes any further description unnecessary. Allen Y. Moore.

Tulare, Cal., July 9, 1878.

New Binocular Eye-Piece by Hartnack and Prazmowski.

MESSRS. HARTNACK AND PRAZMOWSKI, of Paris, are making a new stereoscopic binocular eye-piece, in which refraction is employed in place of two reflections in their former eye-pieces. This diminishes considerably the loss of light, reduces to one-tenth the errors dependent on the finish of the reflecting and refracting surfaces, and equalizes the lines followed by the luminous rays which reach each eye.

The older methods gave two fields unequally illuminated and differing in size, on account of the reflections which one part of the rays suffered more than the others, and also by reason of the difference of route pursued by the different pencils of rays. The fields were only coincident in their central parts, and thus the part useful for binocular vision was limited to this common portion, and the employment of the binocular was confined to weak objectives of low angle of aperture.

The new eye-piece, on the contrary, receives the real image in an erecting glass, with the three dimensions as it is furnished by the objective, whatever it be, whatever its amplification, whatever the angle of aperture. This image is brought beyond the anterior focus of the objective, real, erected, magnified. The observer no longer looks at the object itself in the binocular, but upon its real image, enlarged and having the three dimensions. There is thus obtained a single visible field, equally and entirely perceived by each eye, right and left, whence results in the exactest manner, by the effect of parallax, the double impression which the brain transforms by habit into the single perception, according to the laws of normal stereoscopic vision with the two eyes.

With this binocular, therefore, we may use objectives of all powers and all angles of aperture. The difference in distance between the eyes of different persons is provided for by a rack adjustment which moves the tubes.

Furthermore, this eye-piece, since it is an erector, permits the use of the compound instrument for mounting and dissecting, with all the ease and certainty of a simple microscope.—*Journal de Micrographie.*

[The foregoing describes a form of binocular, which is regarded by the inventors and makers as an improvement upon one based upon the principle used by Mr. Tolles in this country in his well-known binocular eye-pieces. How far the alleged improvement gives advantages over that of Mr. Tolles, if at all, we cannot tell without a more detailed description of the adjustment of lenses and prisms than is as yet before us.—Ed. Am. J. M.]

◆

A Roundabout Walk to Church.

THE writer has frequently, and probably in common with many other microscopists, thought with regret of the truth of Mr. Crouch's assertion before the Quekett Microscopical Club, to the effect that pond life is a subject with which American microscopists are generally but little acquainted, *Volvox globator* being an unfamiliar object to many. Granting that the *volvox* is not as common here as in England, as is undoubtedly the case, for the writer has, during the last three Summers, explored the ponds and ditches considerably without finding it, the substance of the charge is only too true. The reason may be urged that the Americans are too practical and busy a people to spend time exploring puddles and ditches where neither funds or fame are to be found, but even microscopists find time for amusement now and then. The national dislike to walking, and an equally characteristic aversion to open air pastimes generally, are no doubt among the principal reasons for the neglect of a flora and fauna full of interest and beauty. Our running streams and still lakes alike offer new species to the collector, and it certainly seems to the writer that no object can sooner bring its reward of absorbing interest to the individual, and no branch of microscopical study requires less previous preparation or accessory apparatus.

In the course of a walk along Forty-fourth street, near the lake shore, Chicago, a short time ago, a little pool, barely two yards wide, was observed, from which ran a rill of not more than a teacupful capacity. A dip of the vial brought up at least a dozen little green atoms, nothing else but *volvox*, while further queries with the dipping bottle resulted in a find of the greatest variety of animal and vegetable life. Mr. Atwood, one of the party, names the following among the entomostraca and infusoria: Cyclops quadricornis, Canthocampus minutus, sundry of the cypris tribe, Actinophrys sol, Rotifer vulgaris and Anguilula fluviatalis, while among the algæ Mr. Colgrove reports: Oedogonium mirable, Chætophora elegans, fragments of nostoc, Closterium lunula, C. acerosum, Cosmarium teteropthalmum, C. Botrytis, Euastrum verrucosum, Staurastrum punctuatum, several species of diatoms, and the volvox.

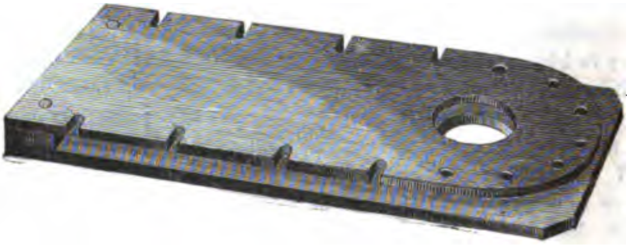
Two, at least, of the party had never seen a live *Volvox globator* before, and if not unduly enthusiastic at the sight of the little living globe rolling gracefully across the field of the microscope, did not restrain their exclamations when one gave birth, in a Cæsarean style, to a family of eight, each of which, after a moment's rest, set their cilia in motion, slowly at first, afterwards more rapidly, and moved away on their voyage of life.

Now the moral of this little tale is two-fold—First, do not remain in ignorance of the beautiful forms that fill with life the ponds and streams around us, for instruction may be gleaned by the student, and entertainment by the dilettante from them; and, second, always take a collecting bottle when you go to church. *

A New Form of Frog-Plate.

THE circulation of the blood in the foot of the frog has always been a favorite subject for exhibition. The subject is so easily prepared, and it may be seen by such ordinary instruments, that few persons who own a microscope need be deterred from attempting to see it themselves, or to show it to others. Of the many forms of apparatus specially designed for holding the frog and displaying its foot, the common brass frog-plate has been most generally used, but it has this disadvantage, that after the frog has been properly secured, it is almost impossible to move the plate under the clips, which, in the cheaper microscopes, serve to retain the object in place on the stage. A very simple addition to the ordinary frog-plate serves to remedy this defect, and enables the observer to bring under view any part of the web of the foot.

This frog-plate consists of two plates firmly rivetted together at one end, with a strip between them which holds them a little more than an eighth of an inch apart. The under plate is plain, with a hole which corresponds with the hole over which the web of the foot is stretched. This lower plate passes under the clips of the stage, which retain it securely, but allow perfect freedom of motion. The frog, after being swathed in a strip of moistened muslin, is tied to the upper plate, the notches at the side of which hold the windings of the string from sliding. Around the large hole over which the web is spread, there are several holes, the object of which is as follows: After the frog has been tied to the plate, its position being so regulated that the web of the foot will come fairly over the hole, the operator takes three pieces of thread, each having a slip-knot at the end. These slip-knots are passed over the toes and drawn tight; the free ends are passed through such of the small holes as are best adapted to spread the web, and by means of small wooden pins, are fixed there. It is well to place a piece of very thin plate glass or thick covering glass under the foot, which must be kept thoroughly saturated with water. After considerable use of this frog-plate, we find it the most convenient we have ever used. It may be made of any suitable material; our first was made of an old cigar box, and then we had some made of brass, but we find that hard rubber is superior to anything else.



A NEW FORM OF FROG-PLATE.

Dr. Carpenter on Angular Aperture.

Concluded from page 112.

IN my former article want of space compelled omission of a few points well worth noticing. But first I desire to amplify one of my former statements, and to correct another.

In comparing 4-10th inch of 100° with 1-4th inch of 75°, I said, "The 1-4th cannot show details of structure as well, although it may resolve just as difficult tests." It cannot resolve as well, because it cannot admit rays of as great obliquity; because it cannot afford as brilliant illumination.

I use the phrase "to show details of structure," and the term "to resolve," as though the phrase and term had exactly the same meaning; I do so because they both depend upon precisely the same conditions. The definition of resolving power given by Dr. C. is so universally accepted that it would be foolish to frame a new one, however advantageous as to clearness and brevity. In substance, Dr. C. says that to resolve is to make evident the existence and separateness of closely approximated markings. To read Dr. C., one would think that the sole purpose of high angles was to "resolve" in accordance with above definition. Mr. Phin, however, with his usual fairness, says on this point that "mere resolving power is not the only valuable feature of well-corrected object-glasses of high angles. They show delicate lines and fibres, and enable us to make out differences of structure, which are entirely invisible to lenses of low angle." ("Selection and Use of Microscope," page 51.)

Near close of article, I said: "Let all objectives (from 1-2 inch up) designed to secure penetration, be made with as low angles as will permit use of medium eye-pieces." Even while I wrote, I had forgotten existence of 1-2 inch; it ought to have, for monocular use, an angle of 30°, or of 40° in case the user owns a binocular. (On this point, I believe Dr. C. to be correct, at least so far as the Wenham form is concerned.)

On page 176 of "The Microscope and its Revelations," Dr. C. remarks: "It is always desirable to employ the *lowest* power with which details of structure can be clearly made out." No doubt, we are all in accord with him here; I may therefore be allowed to register another point in favor of high angles, for all competent judges must admit that of two glasses, with equally good corrections, the one with the higher angle will show given details of structure with lower power.

Dr. C. devotes little space to working distance, but the little that he does say is in favor of medium angles, on account of the fact that of two glasses *of same power* the one with smaller angle has longer working distance. Now I might, by means of an illustration, show conclusively that working distance can only be secured, in greatest degree, by using lowest power objective and highest power eye-piece that are, under the circumstances, possible; but I prefer to rest the case upon the almost self-evident fact that it is more economical, as to working distance, to get increase of power by eye-piece rather than by objective. In order so to do, and yet retain best possible definition and illumination, the objective must have a high angle.

On page 204 of the above work, Dr. Carpenter says: "It may be safely affirmed that the *most perfect* object-glass is that which combines *all* the preceding attributes in the highest degree in which they are compatible one with another." (By preceding attributes he means especially penetration and resolution.) No doubt this is true. But a set of the most perfect glasses is not, of necessity, the most perfect set of glasses that can be selected. Moral philosophers have often proclaimed perfection to be the ultimate end of all right action. I venture to assert that perfection, of any kind, is never an ultimate end, but always relative to an end of some kind. If, now, we inquire what end ought to be kept in mind in the selection, not of a set, but of one or two glasses, we cannot but decide in favor of medium angles; for in consequence of the limited number, we must see that each glass be as self-sufficient or independent of all others as possible. Self-sufficiency then is the end that justifies our calling a medium-angle glass "most perfect." But why should we desire a glass to be independent? Simply because many of us are not able to buy a tolerably complete set. With the ability to buy, the last hope of medium angles "vanishes into thin air." Dr. Carpenter, however, is unable to see this true state of the case, but makes the natural mistake of supposing that because a glass, in view of a certain end, can be rightly called "most perfect," therefore a set of such must be a "most perfect" set.

The problem of angular aperture ought now to have taken on a somewhat different aspect from that with which I commenced my former paper. I then adopted, for the time being, Dr. Carpenter's position, and was content to allow the problem to be looked upon as a contest between penetration and resolution. In reality, it is a contest between resolution (by which I mean resolution proper and *other kinds of detail showing*), plus definition, plus illumination, plus working distance, plus small seeing, plus versatility of power—all arrayed in invincible solidity against a single opponent, penetration. The result is not difficult to foresee; unless some intelligent protest is made, penetration will go to the wall, and science will become a loser thereby. Such protest I desire to make by calling attention to the *only* plan whereby *every* desirable quality can be secured in perfection. "Let all objectives, designed to be used for the purpose of making out solid forms, or relations of parts in difficult cases, be made with as low angles as will permit use of medium eye-piece. Let all others be made with *highest* angles. In other words, let not a medium angle be found in any set that aims at completeness and perfection." As before stated, the first part of the above needs explanation; 30° does not injure penetration to any harmful degree. No glass, except the very lowest powers (3, 2, and 1 1-2 inches) ought therefore to have a less angle. I have a Tolles 1 inch of 30°, which, by the most ordinary diffused daylight shows opaque objects gloriously even under an eye-piece giving power of 200 diameters. A less angle cannot do this on account of want of light.

No one can give minute directions to the many who are not able to buy a tolerably complete set. Many of these, however, expect to buy, as means permit, such a set. To them I would say, "Proceed as though you could get the whole at once." To the remainder I can recommend a course that is definite as far as it goes. Never, under any circumstances, get a glass that is not as perfectly corrected, for spherical aberration, as possible. (A *little* chromatic error is of more benefit than harm). Sacrifice, if necessary, angle and adjustment for cover, but get first-class glasses. The safest course is to give a special order to an optician whose work has gained him a reputation second to none.

For my part, I should prefer a one inch of 30° and a 1-6th inch of 180° (duplex) to any other combinations that could be obtained at same cost. A 1-4th of 50° could be added at small expense, and would leave little to be desired. Such a combination is not cheap, however, and therefore does not meet the cases more particularly under consideration. For all that I can see, such cases ought to take Dr. Carpenter's advice.

I conclude with a remark upon deep or high eye-piecing. There is a natural prejudice of long standing against the use of eye-pieces of greater power than 10 or 12 diameters. In many minds this prejudice amounts to scorn when a 40-diameter eye-piece is spoken of. The same individuals, however, by no means scorn the use of a good "French triplet," with a 5-diameter eye-piece. I have long used just such triplets, and am familiar with their performance under such eye-piece: and I affirm that the definition of my Tolles 4-10th of 100° is, under 1-4th inch eye-piece, somewhat superior to that of my "French triplets" under 2-inch eye-piece. In illustration of this fact I may be allowed to say that the 4-10th inch, under 1-4th inch eye-piece, brings out the markings on *Podura* test scales with a *sharpness* that looks very like perfection. Of course it is not perfection, nor do I believe that *perfection* of definition can be obtained except under low power eye-piece. W. G. Lapham.

Northville, Mich.

Porphyry.

Paper read by Melville Atwood, F. G. S., before the San Francisco Microscopical Society, May 16, 1878.

THE generally accepted meaning of the term porphyry, without addition or qualification, denotes "quartz porphyry," a plutonic rock, with a compact matrix or ground mass, consisting of quartz and feldspar, with distinct crystals of both, having a specific gravity of from 2.5 to 2.6, and containing from 75 to 85 per cent of silica.

What rock the Comstock miners mean when they say porphyry it would be exceedingly difficult for any one to tell. In reading over the published reports of the different Superintendents, they appear to be *continually* meeting with it at all depths, and to the east and west of the different bodies; also in the shape of "horse," or dead ground, mixed with the vein matter, and called "bird's eye porphyry." Now in ninety-nine cases out of the hundred, what they call porphyry does not in any one respect resemble that rock, lacking by 25 per cent the required amount of silica, and having no free quartz. A very slight examination by any one having only a rudimentary knowledge of geology would show that the term porphyry, so applied, is the most unappropriate that could be used to describe either the west or east country rock of the Virginia portion of the great Comstock Lode. The only way I can account for the use of that term is that they prefer it to saying "country rock."

I hardly think it requires me to say how desirable it would be, indeed, necessary, for those conducting explorations and trials on the Comstock Range, to know and be able to distinguish the different rocks they meet with in their operations, particularly as those rocks enclose some of the richest mines yet discovered in the world, and since the cost of those very explorations amount annually to millions and millions of dollars.

It may be urged that the geological maps of the explorations of the fortieth parallel contain most of the necessary information. I would recommend those who think so to examine the maps, or any of the cross sections of the workings on the Comstock, beautifully drawn, I believe the work of Mr. Stretch, but colored by the officers of the Survey, and they will find that the Mount Davidson diorite is colored as syenite, and the black dyke, a dolorite, as andesite. Most of the country rocks overlaying the Comstock on the east are marked as propylite and andesite. The second propylite and andesite are identical in chemical and mineralogical composition, and a slight inspection of the Sutro Tunnel and other drainage levels will show that petrologically they are the same, in fact, the only difference being that the former occurs in sheets, and the latter in dykes. When the feldspar in the so-called prophyte is very much kaolinized, the rock is sometimes termed by the miners bird's-eye porphyry. It may be said that the new work by Ferdinand Zirkel, "Microscopical Petrography," corrects most of those errors, by admitting in the first place that the Mount Davidson rock is a diorite. No mention, however, or section, is given of one of the most important rocks of the Comstock range, the black dyke, and in the explanation of the beautifully colored plates, he has neglected to state the number of times they are magnified. This is a most unfortunate omission, particularly so with respect to the basaltic rocks. My attention was called to it by some remarks in one of the Virginia papers, wherein it was stated that one of the handsomest colored plates was a section of basalt from American Flat. Now, dolorite, anamesite and basalt, are, in a mineralogical point of view, the same rock, differing only in the fineness of texture.

On No. 14 slide I have mounted a section from each of those rocks, so that their difference in texture may be easily distinguished.

Rock and section No. 15 is a sedimentary one, from the Hawaiian Islands—the grains of sand in it averaging 2-100 of an inch in diameter, and, as you will see, consists of coral sand, shells, fragments of basalt, and small pieces of magnetic oxide of iron—the crystals of feldspar in the grains of basalt can be seen with a common lens, and Mr. Hyde has kindly consented to measure the length of them for me.

The following are the approximate measurements of the crystals of feldspar in these rocks:

In the Black Dyke, they average from 7-600 to 20-600 in length, by 1-1200 to 10-1200 in width.

In the Dolerite, they are of irregular shape, but generally about double the size of those in the Black Dyke; while there are small masses containing small needle-shaped crystals 1-300 to 4-300 in length.

In the Basalt, they average from 4-1200 to 9-1200 long, by 1-1200 to 2-1200 in width.

Eight pages, however, in that work, with a colored section, are devoted to what is called "Augite Andesite." Now, though I have taken a great deal of trouble, as yet I have not been able to procure a single specimen of that rock called Andesite. A few months ago, a very good authority on such matters, Alphons Stubel, of Dresden, passed through this city on his way home from South America, where he had been collecting rocks for many years. Knowing that he had been at Chimborazo, I thought it would be a good opportunity to get what I wanted; so when he called upon me I asked him as a favor to give me a specimen of andesite. He said that he was very sorry he could not comply with my request, that he really did not know any such rock.

I am fully aware that looseness in petrological nomenclature is the rule and not the exception, and that many geologists are found writing of totally different rocks under one and the same name. I do not think that any distinction between rocks is worth much unless it can be applied in the field. I have stated that the black dyke, a dolerite, but which from the fineness of its texture might be called anamesite, was one of the most important rocks in connection with the Comstock mines, from the fact that it forms the west boundary to all the vast treasures of the Comstock, no ore worth mentioning ever having been found at the west side of it; therefore every miner conducting operations in that district, ought to possess the necessary amount of knowledge to enable him to distinguish that rock. If you will look at No. 12 rock and section, you will find it is fine-grained and apparently of so homogeneous a texture as not to admit of its constituent minerals being resolved by the naked eye. I have quite a collection of specimens which have been given to me, supposing them to be that rock.

In 1867, when engaged in the examination of the gold mines of North Wales, the well-known mining engineer, Mr. A. Dean, gave me the rough tracing of the working plans of the St. David's mine, Clogan, near Dolgelley, and which I have brought for your inspection. The geological features of that district are the Cambrian rocks, overlaid by the lower silurian. The St. David's vein is partly in the silurian slate beds, and sheets of greenstone (diabase) lying between the slates, and partly in the Cambrians. What I particularly wish to draw your attention to, however, is the transverse section, showing the gold-bearing and non-gold-bearing rocks of the Clogan mines, and the very important fact that only those portions of the veins were rich in gold, or productive, where the walls were greenstone.

Impressed with the truth of the discovery, on my return to California I devoted a large portion of my time to the examination of the enclosing and wall rocks of the gold and silver bearing veins of this Coast. On the formation of this Society, I availed myself of the aid of the microscope to carry on my investigations, but soon found out that to do so with anything like satisfactory results, I must get a collection of well authenticated foreign types, to compare with and guide me in the work. Through the kindness of the late Mr. David Forbes, of London, Dr. Hector, of New Zealand, and in San Francisco of Mr. H. G. Hanks and Mr. Charles Schneider, I have now a collection of some 500 specimens of foreign types, from which, with the assistance of my son, I have cut between 1,400 and 1,500 sections—some of them are very roughly done. I found it necessary to have two or three from each specimen, some cut very thin and others rather thick, to show color and for examination with the aid of the parabolic illuminator. My collection of rock sections from this Coast is large; but the result of it all amounts to this: I found that every step I took I was travelling on a road that led me far away from what I wanted, which was, a method to make it easy for my fellow miners to understand and distinguish the enclosing and wall rocks of the different lodes they were working—those rocks having so much to do with the productiveness of the lodes.

By the merest chance, I have found out a simple way, which I think in a great measure will partly fill the gap so much needed.

The different pieces of rock which I now present to the Society are roughly prepared after this method, and made so that an inspection of the outer surface, viewed as an opaque object, with only the aid of a common hand magnifier, will give all the information ordinarily required by the miner, and in most cases he will find that he is able to distinguish the structure and composition of all the commoner rocks, so that with the help of a small collection of foreign types, prepared after the same fashion, he can compare and identify those under examination. It will be necessary for them to read up a little on the subject, and to acquire a rudimentary knowledge of geology, which I think can be best done by a careful study of such works as ".The Student's Manual of Geology," by J. Beete Jukes, 1857; "Text Book of Geology," by Dana; "A System of Mineralogy," by Dana; "A Treatise on Lithology," by Van Cotta, English edition, by P. H. Lawrence; and "Determination of Rocks," by E. Jannettas, translated by Plympton.

The rock for examination may be prepared as follows: First wash the specimen clean, using a brush to get rid of any clay and dirt; then select the side or part you wish to examine, and grind it down on a piece of sandstone (a shoemaker's sharpening stone) until a perfectly flat surface is obtained. This will occupy but a few minutes, unless the rock is very hard. The surface should then be worked down still finer with a square emery file, using water, and after you have obtained a sufficient polish, wash the rock again, and then let it dry gradually, either on a stove, or, what is better still, a little brass table, with a spirit lamp, the same that is used for heating slides. When perfectly dry, heat it again to a point, so that you can barely handle it; then polish the varnished side while hot with a mixture of one part of Canada balsam to three parts of alcohol, which must be warmed before applying it, and laid on with a camel's hair brush. It will soon dry, and if left for a day or two will harden, so that you can handle it without injury.

The effect of this treatment is remarkable, particularly on the lavas, as you will see by the specimen of trachyte lava from Bodie, which I now present to the Society.

In conclusion, it is with great hesitation that I have ventured to bring this matter before you, but I do so well knowing that more searching and exact methods of investigation are now demanded by those conducting large mining operations, and that such terms as porphyry, for any and all enclosing, or wall rock, that may be met with in such mines as the Comstock, and the term green chlorides, for the rich ore, will not be deemed a sufficient explanation, or tend to give the mine adventurers that confidence in the reports of their employes which they should be entitled to, particularly when it is known that the rock is not porphyry, and that the chloride of silver is one of the accidental minerals met with in the vein matter.

I am in hopes that by thus breaking the ice, others more capable in every respect than myself will be induced to communicate the results of their researches on the subject.

All that can be claimed for the mode I have suggested to you for the examination of rocks is that it is a rude and simple way of determining some of the commoner ones, but the application of the microscope, even now quite in its infancy, is, after all, what we must trust to for exact or reliable results.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

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As we desire to place a COMPLETE set of the Journal at the disposal of our subscribers at a moderate rate, We offer Vols. I and II, bound, and Vol. III in numbers as issued, for $2 50 *net*. These who wish to have their numbers of either Vol. I or Vol. II bound can do so for 35 cents. Postage 10 cents additional.

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorised to receive subscriptions and advertisements:

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JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

The January Number.

THE number of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878, is entirely out of print, and we can no longer supply it to subscribers.

We will gladly pay ten cents apiece for clean copies of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878.

The American Quarterly Microscopical Journal.

OUR readers will see by our advertising colums that a new journal of microscopy is to be published next October. This journal will occupy a field entirely different from that of our monthly journal, and will aim to furnish extended and elaborate monographs on special microscopical subjects. The well-known ability of the editor, Prof. Hitchcock, is a guarantee that the new journal will take a high position among the scientific periodicals of the world.

The National Microscopical Congress.

WE have already announced that at the invitation of the Indianapolis Lyceum of Natural History, a National Microscopical Congress will be held in Indianapolis commencing on Wednesday, August 14, and continuing not more than one week.

The proposed objects of this convention are an increased personal acquaintance and social intercourse between the workers in this department of science throughout the country, the reading of scientific papers on subjects pertaining to the microscope and its use, and the consideration of such questions of interest to microscopists as may reasonably be offered by members in attendance.

The invitation to this Congress has been made very broad—every person interested in microscopy, whether a member of a society or not, being invited to attend. The convention has been called at a central and accessible point, during the time of the usual summer vacations, and one week before the meeting of the American Association for the Advancement of Science, in order that members of that association may be able to attend the Congress on the way to St. Louis. Members can also attend the St. Louis meeting by paying half fare to St. Louis and back.

Liberal offers of the most generous hospitality have been tendered to members of this Congress by the Governor and other officers of the State, and the Mayor and citizens of Indianapolis. Special arrangements have been made for greatly reduced rates of fare by railroads and steamboats. It will thus be seen that the gentlemen having the meeting in charge have taken every pains to secure a large attendance. Those who desire to learn about railroad rates, hotel accommodations, etc., should address Dr. W. W. Butterfield, Indianapolis, Ind.

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Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Angular Aperture Again.

Ed. Am. Jour. Microscopy—Prof. Romyn Hitchcock, having concluded his essay on this subject, it may be well to examine his last effort.

Prof. H. has evidently forgotten the origin of the discussion—"I challenge Dr. Pigott or *any one else* to get through an immersion objective any more light (or angular aperture) than through a dry one."—*Wenham, M. M. Jour.*, *about* 1870. This, in fact, is the whole question. Prof. H. introduces a new variation of Wenham's definition of angular aperture. Without any pretence to a knowledge of "optical law," (whatever that may be), I will offer another from the stand point of a microscopist: "The angular aperture of a microscope objective is twice the angle of incidence of the light that passes through the objective to the eye-piece, and gives distinct vision of the objects in the field." This is comprehensible by every one who uses the microscope, without the aid of algebraic formulas.*

Now, will any immersion objective admit light at any larger angle of incidence than any dry one can? Prof. Hitchcock, in fact, gives up the point when he shows by his drawing, on page 132 of this journal, how the light can be made to pass through the *slide*. But Prof. H. says: "We find that it is impossible for an objective to take up light from a balsam mount when the interior angle is 82° or more." Now that is the real practical question; not for discussion or theorizing, but for practical experiment. There are an abundance of objectives within reach of Prof. H. claiming 180° air angle, 84° to 95° balsam angle, yet he does not mention having investigated the performance of a single one. In this he has *not* followed the example of his high authority, Mr. Wenham, who did report the trials of two, using in one instance an immersion lens dry, and in the other reporting an angular aperture some 30° less than was found by a gentleman who was present at the trial.

Prof. H. also says, "It is fact that this whole matter of increasing the balsam angle over 82° by some device of this kind, has absolutely nothing to do with the objective." Indeed! This is a most astonishing fact. The objective and its construction have everything to do with utilizing rays of more than 41° of incidence. Prof. H. must experiment before he dictates.

I will ask him why he has entirely ignored the *optical* arguments of Dr. J. J. Woodward and Prof. Simon Newcomb, and the computation of Prof. Reuel Keith? Any one taking the position of Prof. Hitchcock on this subject must necessarily refute, if he can, all that has been published on the other side.

However, the fact that objectives are constructed with more than 82° balsam or glass angle, may be considered settled beyond all question.

On the affirmative side we have the following physicists: Tolles, Helmholtz, Abbé, Newcomb, Keith, Woodward, Blackham (unpublished). Microscopists: Woodward, Blackham, Mayall, Pelletan. Practical Opticians: Tolles, Spencer, Hartnack, Zeiss, Powell & Lealand.

On the other side we have: Wenham, Brakey, the late Dr. Lawson, and Hitchcock.

Boston, July 28, 1878. CHARLES STODDER.

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Oil Immersion Objectives.

Ed. Am. Jour. Microscopy—I received from Carl Zeiss, a short time since, one of his newly constructed oil immersion objectives, 1-8th inch focal distance, and thinking its performance, in an eminent degree, worthy of mention, I inclose a short description of it, which I hope will not be unacceptable to the readers of your journal.

The immersing fluid used with this objective is oil of cedar, which, after numerous experiments, is found to be the most useful for this purpose, as it affords a refractive and dispersive power almost exactly that of crown glass, so that when in use the front lens, immersing medium and cover glass may be optically considered as but a single piece of crown glass, thus obviating the necessity of cover correction. To test this practically I examined slides of *P. angulatum*, with covers of varying thicknesses of 1-60, 1-125, and 1-250 inch respectively, and found the results equally good with either central or oblique light.

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*Some of Wenham's, and also Prof. Abbé's formulas, give an angular aperture as shown by a distant object. This is not the purpose that the microscope is used for, or the way it is used.

The angular aperture of this objective is extreme—113° in balsam. Its performance is exceedingly fine, scarcely equaled by that of any objective I have ever seen, and I am familiar with the productions of the best makers. Its definition is simply superb, with the field flat, brilliantly illuminated, clear and limpid, with a power of resolution competent to any known test, and showing *Amphipleura*, when dry mounted, with the utmost facility, when illuminated with a common hand lamp and mirror. A skilful anatomist, accustomed to the very best objectives, unhesitatingly avers that he has never seen anything equal to it when used for the examination of histological preparations.

To the petrologist it has the especial merit of rendering the use of the cover unessential, as well as the polish of the surface of rock sections etc., with that extreme care usually found necessary, as the nature of the medium prevents that breaking up and diffusion of the light by the rough surfaces. This will be high recommendation to one who has fragile material to prepare.

The working distance is amply large, and I think we may finally, with good reason, consider this production of Mr. Zeiss a genuine advance toward objective perfection.

Charlestown, Mass. L. M. Willis, M. D.

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Oiling the Microscope.

Ed. Am. Jour. Microscopy—Please allow me to make a suggestion in reference to the microscope, viz: that the working parts should be well oiled. It is not an uncommon occurrence to find that the fine adjustment does not work properly, or that the rack and pinion "jerks." This may, in some cases at least, be remedied by using a little good oil.

If the microscope is used where there is dust, it will require occasional cleaning of the fine adjustment screw, etc.

Tulare, Cal. Allen Y. Moore.

TRANSACTIONS OF SOCIETIES.

[The following account of the Reception of the San Francisco Microscopical Society was sent us in proof, without any indication of its origin. While embodying much pleasant news, it contains some scientific mistakes, which show that it has not been carefully revised by the Secretary of the Society.—Ed. Am. J. M.]

Microscopical Society Reception.—The sixth annual reception of the San Francisco Microscopical Society was held at the Mercantile Library Hall on Thursday evening, May 23d, and the large gathering of invited guests, the animated courtesy of the twenty-two exhibitors, and the prolonged interest manifested in the almost innumerable phases of nature's minute beauty which were shown, proved that this one day in the year, in which the microscropists of our city leave their studios for the reception-room, is growing more and more to be an established event in the social life of San Francisco.

We started from the entrance door with the well classified catalogue in hand. President H. C. Hyde, whose instrument, a fine Zentmayer, caught every eye, had upon its stage living vegetable forms—diatoms, protococcus, etc. Our eyes passed from his slides to an odd-looking instrument, built when our grandfathers were young, the property of Mr. Chas. Banks, which stood in strange contrast with the dazzling mechanical perfection of the Zentmeyer. It soon occurred to us that the exhibitors were classified in three sections—vegetable, animal, and mineral,—in proof of which we found Mr. Charles Banks near President Hyde, in genial supervision of his three instruments, a much observed radiometer, and the slides of water lily raphides, starch grains, and the deutzia's beautiful stellate hairs, which he described while adjusting for the varying eyes his unique aluminium instrument. Still in the vegetable world, we passed to Mr. J. P. Moore's table, to find it loaded with "mushrooms" and "toadstools," with admirable drawings, with a curious and most efficient microscope; to find behind it Mr. Moore in his instructive discourses over his favorites, the fungi; the humble but honest working servitors of the plant world, enormous builders of the night time, while your gaudy aristocrats, passion flower and rose, sleep; improvers of waste places, content with humble food.

Mr. J. Wickson led us with his neat monocular into the hearts of trees, showed the very fibre of the heavy Honduras mahogany, so precious to the cabinet-makers of fifty years ago; and the boxwood, so indispensible to the engraver; and then, in a double stained leaf, pointed out how the curious vascular tissue of the trunk continued to the furthest extremity of each leaflet. Ferns are beautiful to the unassisted eye; but we never suspected the secrets of their brown spots, the "fruit" till

Mr. G. L. Murdock revealed them, showing not only their spores and capsules, but also those of the liverwort. With Mr. J. A. Langstroth we felt more amongst familiar matters. From his pretty bouquet he picked the pollen of arbutus, snapdragon, fuschia, tritonia and pansy, and showed these little globules to be as varied in their structure as ivory carvings. Leaves breathe, too, it seems, for his microscope magnified a begonia leaf, and there we saw innumerable little gaping mouths. Mr. W. H. Lent set before us the most minute plants, marine and fresh water algæ and desmidiaceæ, whilst Mr. Bleasdale, next at hand, led us first to fossil botany, exhibiting petrified wood, and then magnified some of those minute photographs of which we hear—the Declaration of Independence in the space of a pin's head, etc.

It was evident at Mr. Xenas Clark's table that we had passed from the vegetable to the animal kingdom; for beneath his instrument were seen polycistina, the finely shaped glass shells of microscopic animals; sections across sea urchin spines which reminded us of crocheted mats in their texture; and the many toothed tongue of the snail. We had heard of the deep sea dredging expeditions, and found to our pleasure that Mr. J. Z. Davis had secured a specimen from the Challenger's last soundings at 1950 fathoms. With this were also to be seen foraminifera shells and the skin and scales of the sole.

No department of zoölogy is more popular than entomology, and it was gratifying to find it so well represented here. In insect anatomy Mr. William Ashburner had the mouth of the honey bee, a blow-fly's proboscis, and the head of culex pipiens—literally singing gnat—that musical vagabond, the mosquito. After seeing the fierce cutlery of his mouth and the bushy plumes that are his ears, we wonder neither at his cunning surgery or his love of melodies.

From the more chivalric parasite of the air, Mr. W. F. Myers led us to the more permanent feeders on our bodies, the itch insects, the face insects, and then the cheese mite, showing adult and larval forms of all. Mr. C. H. Williams attracted much attention with his living mosquito larva, showing an adult, also, and Mr. S. B. Boswell gave us a brilliant finale in the insect department, with his butterfly scales, beetle wings, and the down of the moth.

Every one missed the face of Mr. Kinne, who, after a long journey and elaborate preparation, had been unfortunately prevented from showing the circulation of blood in the living fish's gill, oyster embryos, and many unique things.

Dr. S. M. Mouser led us to the matters of physiology with the circulating blood in the frog's mesentery, a subject he has brought to perfection with apparatus of his own invention, and then, for comparison with those of the amphibian, showed human blood corpuscles.

With Mr. J. H. Wythe we were still in minute anatomy; one slide was the curious insect eating organ of the plant utricularia purpurea; another the eye of a cuttle-fish, and another the lung in pneumonia.

At Dr. J. P. Whitney's microscope we found ourselves investigating the minute structure of our own body; here were nerve tissues, healthy and diseased, and the villi of the stomach, of the mouse, to be sure, but very much like our own, and passing to Dr. S. W. Dennis, the beautiful canal, lake-like system of cavities in human and bird bones were kindly explained to us. Mr. John Hewston, Jr., displayed with his speccialty, the polarizer, the usual gorgeous colors given by that piece of apparatus, showing magnesium, silver and nitre crystals. Minerals and rocks were now the predominating slides, and from Mr. J. R. Soupham we heard much about his crystals of carbonate of copper, Egyptian porphyry and fossil bearing limestone, whilst Mr. O. H. Denison caught the eyes of all interested in mining with the resplendent crystals of gold, silver and cinnabar.

Thus, with the primeval rock stuff of nature, the round of display was ended, and with a parting glance at the bright audience we passed out into the starlight, to think what an overpowering vision of a world to which we are ordinarily so blind, this evening had brought us; to think, perhaps, with George Eliot, that "If we had a keen vision and feeling of all ordinary life, it would be like hearing the grass grow, and the squirrel's heart beat, and we should die of that roar which lies on the other side, of silence," and that "As it is, the quickest of us walk about well wadded with stupidity."

The San Francisco Microscopical Society.—A regular meeting of the San Francisco Microscopical Society was held at the Society's rooms, June 6th, President H. C. Hyde in the chair. In the absence of Secretary Clark, Mr. Wickson acted as Secretary pro tempore. There was a good attendance of members, and Mr. Frank Kennedy as a visitor.

Besides the usual acquisitions to the library, in the form of recent scientific periodicals, there was, by purchase, Mr. Andrew Murray's work on "Economic Entomology," which is especially valuable, for its descriptions of animal parasites and acari generally. There was also received from Germany the first of a series of exceedingly valuable charts, entitled "Zoologischen Wandtafeln." These are large, accurately drawn, and beautifully colored plates, suitable for mounting and hanging upon the walls of the Society's rooms. The plates thus far received include the coral polyp, rhizopods and crustacea. These were examined with much care, and pronounced the finest large drawings of these subjects the members had ever seen. They will be carefully mounted and hung.

An addition to the library, which was received with much valuable comment, consisted of seventy-five volumes of microscopical literature, purchased from the library of Dr. A. Mead Edwards. President Hyde gave an interesting analysis of the acquisition, stating, in conclusion, that it rounded out the Society's library in several important directions, and would be of lasting value and interest to the Society.

An interesting slide was received for inspection from Mr. Allen Y. Moore, of Tulare. It was "Abbe's Test Platte," for testing chromatic and sperical aberrations, which Mr. Moore recently received from Germany. Unfortunately, the slide was found to be badly broken, when the package was opened, and, consequently, no satisfactory examination could be made of its merits. In Mr. Moore's letter, he makes the following announcement:

"I have recently resolved surirella gemma (dry) into longitudinal lines by a Gundlach's one-fifth objective (105°), with very oblique sunlight. That is almost too good to be true, isn't it? I have, however, a witness. The objective is owned by Dr. A. C. Stokes, of Trenton, N. J., and is very good for the price, $15."

A good part of the meeting was devoted to conversational discussion of ways and means for increasing the society's acquisitions in an important direction, the details of which will doubtless be made known at a future meeting.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

For exchange, cluster cups on leaves of geranium, gooseberry and ranunculus. E. W. Holway, Decorah, Iowa.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

British plants and bird's eggs for American ditto. J. A. Sanford, 289 Summit street, Toledo, Ohio.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 81 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

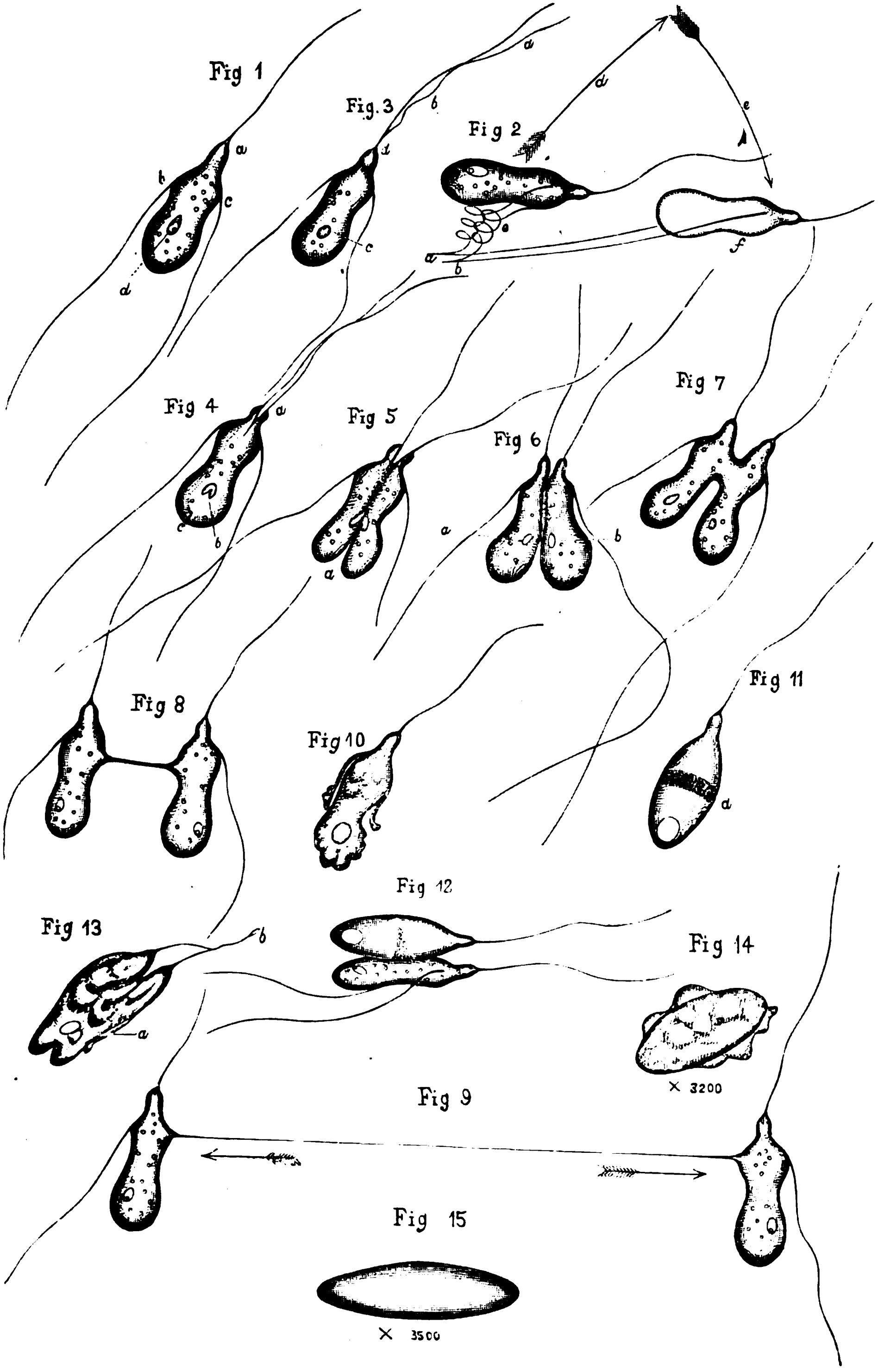
Hamilton, Up. Held. and carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of manzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque: and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Magic lantern, nine slides (two mechanical) in complete order, in exchange for good compound microscope. T. R. Barwood, Flatbush, L. I.



SEPTIC ORGANISMS. Rev. W. H. Dallinger. (Plate I.)

Fig 16

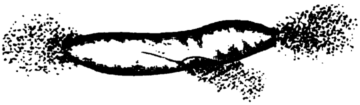


Fig 18

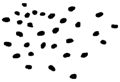


Fig 19

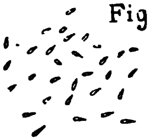
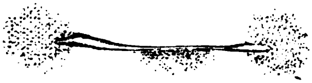


Fig 17



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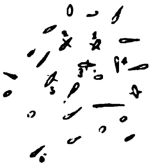
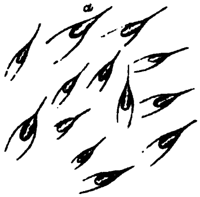


Fig 21



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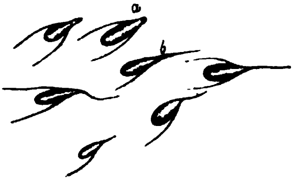


Fig 23

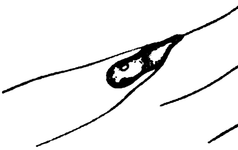


Fig 24

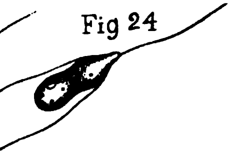


Fig 25

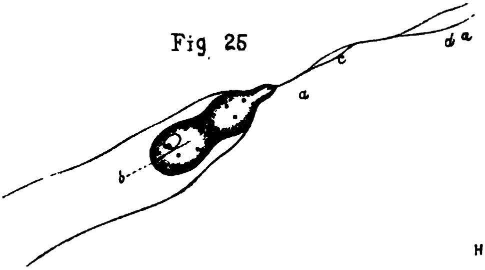


Fig 26

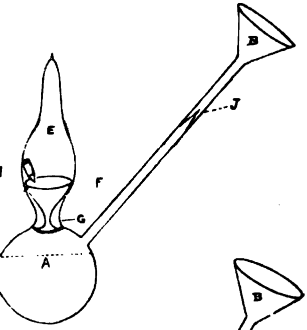
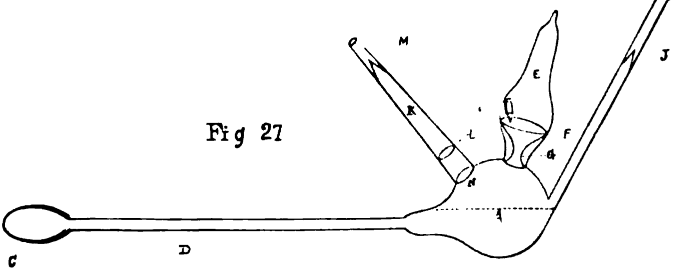


Fig 27



SEPTIC ORGANISMS. Rev. W. H. Dallinger. (Plate II.)

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, AUGUST, 1878. No. 8.

"On the Life-History of a Minute Septic Organism, with an Account of Experiments made to Determine its Thermal Death Point." By Rev. W. H. Dallinger.

From the Proceedings of the Royal Society, No. 187, 1878. Communicated by Professor Huxley, Sec. R. S. Received March 26, 1878.

With Two Plates.

NEARLY four years since, in examining an infusion of animal matter, which had, unfortunately, been diluted with water, and had vegetable substances placed in it, I observed a minute and intensely active organism, which, on closer and more careful examination, I found to be of a form entirely new to me. I therefore determined to endeavor to discover its life-history; but the diluted infusion was unsuited to it, and in the course of five days no living form remained. During this time I had been able to determine very little that was consecutive, but had seen enough to lead me to desire to find it again; and for the two following years I steadily examined all the infusions within my reach, as well as all probable places besides, but in vain. And it was not until the latter part of the summer of 1876 that I found it again. It appeared then, in a maceration, in which the body of a vole was decomposing. The maceration was only three weeks old, and this organism had evidently only just arisen; it increased daily in vigor and numbers, and in three weeks I was at liberty to study it continuously.

For this purpose I employed the "continuous stage," jointly devised for preceding researches,* by means of which a drop of the infusion could be kept under examation, without evaporation, for an indefinite time, and with the most powerful lenses.†

My method was to follow out, as far as possible, the morphological details separately; and then to steadily follow one form from its earliest to its most mature condition; thus discovering how the different states were related, and making out an unbroken life-history.

Most of the more difficult and delicate

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*Vide "Further Researches into the Life-History of the Monads." Monthly Micro. Journal, Vol. XI, pp. 97-99.

†Linen instead of bibulous paper is now used as the agent for conveying a constant supply of evaporating moisture to the chamber in which the organisms are examined in this piece of apparatus.

work was done with an entirely new lens, made specially for me by Messrs. Powell & Lealand; and which is nominally a 1-35th inch lens. It was made specially for this class of investigation, for which it is admirably adapted. Its "working distance" is sufficient; its "penetration," for such a power, is extremely great, its angle being moderate; and its "definition" is as sharp and clear, when properly used, as that of the finest 1-4th or 1-8th. I also had the advantage of the use of the four new lenses made on a "new formula" by the same makers, viz., a 1-8th of low angle and great penetrating power; and a 1-8th, 1-12th and 1-16th of high angles. I also used the 1-25th and 1-50th lenses.

One of the difficulties attending the study of this organism was its extreme rapidity and caprice of movement. Its normal form is depicted at Fig. 1, Plate 1. It is there magnified 3,000 diameters. Its sarcode is clear, and to all the lenses employed structureless. It is usually found to have minute vacuoles scattered through it. The form of the body is distinctive. Its greater part is a long oval, slightly constricted a little above the middle. But from the front, or shorter portion, a kind of neck (*a*, Fig. 1) protrudes, from which proceeds the front flagellum, which is extremely fine, and from one and a half times to twice as long as the body. Below this, and at the sides or "shoulders" of the organism, two other long and fine flagella arise, proceeding backwards, as seen at *b*, *c*, *ibid.* In addition to this, there is always a nucleus-like body slightly to one side of the lower part of the organism, as seen at *d;* and with the higher lenses and delicate manipulation there was frequently seen, within this, an extremely minute globule, also indicated at *d.* But as this was not always present, even in the normal state of the organism, it was probably not important.

The extreme length of the body was the 1-4000th of an inch. It rarely exceeded this, and was often less.

It swam, as I have said, with great rapidity; and all its movements were most graceful, varied and controlled. Its usual mode of motion is in a direct line, or in curves; and with its trailing flagella behind and its active anterior one, it is a very remarkable object. But the suddenness with which it can arrest its most rapid movement, or change it in any direction up, down, or directly reversed, is still more remarkable. In this the flagella at the sides are brought into active operation; sometimes both being spread out like long arms; at other times one being stretched out and in vigorous action, while the other is closely pressed to the other side, and so forth, giving this organism a control over its movements which is of extreme interest. Indeed the apparent volitional mastery which this seemingly structureless speck exercises over these equally structureless filaments, for the determination of its course, cannot be seen and studied without wonder.

But besides this free swimming movement, it was capable of the most vigorous motion in an "anchored" state. Most of the larger septic organisms belong to, or are associated with, certain conditions of the decomposing matter; and disappear before the advent of other forms, when that condition is past. This one was associated with the general breaking up of the decomposing animal matter; and the movement which I am about to describe apparently contributed to this. It was a powerful springing motion. The trailing flagella became attached to the floor, as at *a*, *b*, Fig. 2, by what means could never be discovered; but the attachment was very secure, and could be discontinued at any moment. Directly the anchorage is made, the two anchored flagella, with the utmost rapidity, coil in a spiral, as at *c*, Fig. 2, bringing the body of the organism nearly to a level with the floor. With equal suddenness it darts up in the line indicated by the arrow, *d*, and thus having reached the limits of its flagella, it moves down, with equal rapidity, in an arc of a circle, of which the flagella are the radius; indicated by the arrow *e*. In this way the whole body is brought down on the point *f*. But the matter to be noticed is, that this is never done, except upon a fragment of the decomposing tissues in the infusion. And if a small fragment be taken out at any time and examined, it would soon be encircled by thousands of these forms incessantly darting up and down upon it in the way described; and careful observation showed that they, by this means, rapidly changed the form and diminished the size of the little particles so attacked. No morphological changes are at all apparent in those that are in this condition, but they are continually freeing themselves and swimming away, and others are constantly coming.

The changes now to be described will be understood to be given as the result of long-continued and repeated effort. Failure is very much more frequent than success in working out the preliminary details, but pre-eminently so in steadily following to the end the changes undergone by a minute organism.* I merely record the final results, which have issued both from the study in detail of phases in the life-cycle of the organism, such, for example, as the minutiæ of the method of fission and fusion—and also from an unbroken observation of its comparatively short life-cycle, which was three times repeated.

Following then, steadily, a normal form, which has just freed itself from the springing condition, as Fig. 1, the first real indication of change, though by no means the first to be *discovered*, is a splitting of the anterior flagellum, as seen at *a* and *b*, Fig. 3, and the moving of the nucleus to the centre, as seen at *c*. With a power of from three to four thousand diameters, there may also be seen a delicate line under the base of the flagellum, as shown at *d*. In the course of from thirty to sixty seconds this has widely opened, and the base of the flagellum has divided, as seen at *a*, Fig. 4, while at the same time the nucleus shows an incision in the direction of its length, as seen at *b* in the same figure; and a similar incision has commenced at the posterior end of the body, as shown at *c*. In a very few seconds more, this slight incision (*c*, Fig. 4) is the origin of a wide opening, as seen at *a*, Fig. 5, above which it will be seen that the nucleus has almost divided, and a pale line runs through the body substance from the upper to the lower opening. The posterior opening widens much more rapidly than the anterior one, as Fig. 6 shows, depicting a condition ensuing in from one minute to four minutes after that shown in Fig. 5. And at this stage the nucleus has split into two and the divided parts occupy distinct positions, as shown at *a*, *b*. The upper or anterior split now widens as well as the posterior one, as shown in Fig. 7, leaving the two parts merely united by a neck of sarcode. Great vigor of movement now ensues, but of an irregular kind; and instead of being forward, is from side to side; when suddenly the distance between the two parts widens, as in Fig. 8, a stretched fibre of sarcode alone uniting them. Movement is still apparently concerted, and is *from* each other, the fibre of sarcode becoming speedily thinner until it has stretched to double the length of an ordinary trailing flagellum; this is shown in Fig. 9; and in a few seconds more, by a vigorous movement of each body in opposite directions, as the arrows indicate, the fine filament of sarcode snaps in the middle, and two perfect forms are thus set free by fission.

The process is carried on with great vigor, and is *apparently* the only metamorphosis to which the organism is subject. In nine separate cases a single form was carefully

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*In fact hundreds are followed which, from one or more of many causes, do not complete the cycle of their lives. It may be arrested—and frequently is—by death, in the earlier stages, in the middle, or still worse towards the end. In the same way there may be failure by the individual form being lost amidst a crowd of others, or by slowly working its way to the little ring of liquid at the edge of the cover, and then going out into it, and so making further study impossible. Or the apparatus may be at a critical moment a source of trouble; the delicate balance between the moisture carried over by capillarity into the chamber containing the fluid with its organisms, and the evaporation taking place, may by some means, such as a sudden change of temperature, be broken, and nullify hours of patient, and, but for that, successful work. In every such case there is but one method open—it is to begin again *de novo* upon another form.

followed—that is to say, a vigorous form in each case was watched from its first act of fission, one part of the divided organism being constantly followed. The whole process of division, from its visible beginning to its close, took place in from four to seven minutes, and was recommenced during the first hour in periods not exceeding three minutes. For the next two hours the intervals would be from seven to ten minutes, and after this the intervals became indefinite, not being less than twenty nor more than forty minutes.

Following the first separated segments, as represented by one part of its divisions, in all its subsequent separations, as begun and carried on by nine separate organisms in which fission happened for the first time, the terminus of the process of fission in the last of the segment forms in all the cases, was *death* in six of the nine instances, and entire metamorphosis in the remaining three. In the cases in which death ensued, the process of fission was continued for seven hours in one case, six hours in three cases, and five and a half hours in the remaining two. In the cases in which metamorphosis took place, three hours in one case, and four hours in the remaining two, terminated the period of fission. There was then inaction in this last segment form, and the appearance indeed of the loss of vitality; but the first indication of a difference betweed this and the more frequent cases of vital collapse, was the rapid "clubbing," or gathering into knots of the trailing flagella, followed by a rapid enlargement of the nucleus, and a glittering, rapidly amoeboid condition of the entire body. This condition is shown in Fig. 10. The changes are now very rapid: not more than seventy seconds elapse before the trailing flagella are wholly fused with the body substance, and while the head-and-neck-like protuberance pointed out in Fig. 1, is preserved, the body, having lost the lateral or trailing flagella, becomes oval; with an immensely developed nucleus, as shown in Fig. 11. It swims now with great ease, but always merely in a straight line, and always takes a sudden dart backwards before changing the direction of its motion. It may swim in this way for from a quarter to half an hour; but during this time a band of granules is formed, at first faintly, and afterwards very distinctly, which is shown at *a*, Fig. 11. In this condition it swims directly into the midst of a group of forms in the springing state, shown in Fig. 2, and the utmost care is needed to keep it in view; but as a rule not many seconds ensue before it has firmly attached itself to one of the springing forms, which at once unanchors itself, and both together swim freely and vigorously about, as shown in Fig. 12. They now swim in concert for a very variable period, but generally from thirty-five to forty-five minutes, when their movements become sluggish; the trailing flagella of the lower form become inert and fall upon, and become fused with, the mass of sarcode; meanwhile the bodies have rapidly been uniting, and the two nuclei become fused together, as seen in Fig. 13, while the anterior flagella become, in their extremely sluggish movements, at last, entangled with each other, and also melt together, as shown at *b*, and all movement ceases. In the course of ten minutes, from this condition, all trace of the separate bodies is lost, a more or less regular oval form is taken, as shown in Fig. 14; at the same time a slow amoeboid disturbance of the sarcode is visible, which diminishes until perfect fusion results, which occurs in the course of twenty minutes, all trace of the nuclei having vanished; and the oval gradually elongates until it reaches the tight, glossy, still condition shown in Fig. 15.

This, as previous experience had led me to expect, proved to be a cyst charged with spores. On the first occasion, I anticipated a long continuous watch; but at the end of three hours there was a sudden falling in the middle of the spindle-shaped sac, and a general alteration of form, which led me to earnest effort to discover some discharge. And that it was taking place there could be no doubt, for there was a rapid diminution in the size of the sac; and there were apparent fractures in the delicate investing membrane; but nothing more than cloudiness at the ends could then be made out. I was using the 1-16th new formula lens (dry), and exhausted all expedients, in vain, to make out the real cause of the change; and as it is hopeless to attempt to change a lens successfully under such circumstances, there was nothing to be done but await another opportunity, using another lens. This 1-16th had proved of great value throughout in the detection of minute structure and change of form; but the kind of illumination which best reveals extremely minute semi-opaque bodies, is the perfect central illumination which I have endeavored to describe in the *Monthly Microscopical Journal*, Vol. XV, page 165. That is to say, the illumination of the whole field through a circular aperture in the diaphragm from the 1-80th to the 1-100th of an inch in diameter, through the centre of which aperture the optical axis of the substage condenser, if continued, would pass. But for this special method, the new 1-16th is not so efficient in my hands as the 1-25th, 1-35th, or 1-50th.

Having, therefore, ultimately secured another sac, I determined to use the 1-35th, as being, as I believed, the most suitable lens for the purpose. In the still condition of the sac, ample time was given for the most delicate adjustment of the light and of the lens, and the watching was begun under the best conditions.

Not the slightest movement, either within or without, is visible while the cyst is in this condition; and the time over which this inactivity extended was never less than three hours, nor more than five hours, in the eight separate instances which I studied. In the second instance the length of time which elapsed was four hours. At the end of that time, without reason discoverable at the moment, there was as before a falling in of the centre of the cyst, and an irregularity in its shape, with a visible and rapid diminution in size. At first nothing but a cloudiness at the two ends could be discovered; but, by a little delicate adjustment of light and lens, there became distinctly visible an outflow from the two ends and the middle of the cyst, of the most exquisitely minute particles which I have ever seen; and as the quantity flowing out diminished, their segregation became more complete, and their clearness and independence more manifest.

The nature of the "continuous stage"—which keeps the drop of fluid under examination from evaporating—is such as to compel the use of the microscope in an upright condition, in order that the stage of the instrument may be perfectly horizontal. On this account the ordinary "camera lucida" is of no avail, or only of use by special and difficult arrangements; but a beautiful little instrument, made by M. Nachet, of Paris, specially meets this emergency, and enables us to make camera lucida drawings with great ease and accuracy. I had, therefore, by anticipation, arranged this apparatus: and when the outflow had continued for about five minutes, made a drawing of the cyst, of which Fig. 16, Plate 2, is an accurate copy. As, of course, the minute particles were in rapid movement of outflow, they were put into the drawing, not with camera lucida, but subsequently; and they accurately represent what was seen at the time. The emission continued for about forty minutes, becoming more and more feeble, until at last there was no more movement. At this stage there were many of these minute particles well segregated round the ends of what remained of the cyst; and then I was able, not only to make a drawing of the delicate white film of the cyst, but to indicate by fine dots the relative appearance of the cyst and the still particles. This drawing is reproduced at Fig. 17.

The entire details of the subsequent history of these minute bodies were, of course, only made out by several successive and continuous observations on the emissions of different cysts. But, in each case, the lens was fixed upon some of the minute bodies that remained near the exhausted cyst, and then the observation was unbroken and continuous to the end. When first seen, these exquisitely minute specks are strongly opaque; but as they are attentively watched with a magnification of 5,000 diameters, they, in the course of from twenty to forty minutes, become quite clear, and would be much more difficult to find in this condition than when first poured out. But, following upon this, there is a distinct elongation, which is indicated at Fig. 18, and this proceeds so that, at the end of an hour and a half, they were in the shape and relative size shown at Fig. 19.

On the first and second occasion on which the observations were made, very little was made out, except the succession of the metamorphoses; but on subsequent occasions, when a careful scrutiny for the discovery of delicate changes was made, the clear, sharp, defining power of the new 1-16th objective was of great service; by its means I was enabled to discover the first indication of the origin of the anterior and lateral flagella in the developing germ. At the end of an hour and a half after emission from the sac, the long oval form which the germ had taken (indicated at Fig. 19) was always associated with a sharpening at one end. This became rapidly sharper and longer, as seen in Fig. 20, at 4 and 6. This always developed into the interior flagellum. But at about the same time—generally about two hours after emission from the cyst—there were pushed out two delicate points of sarcode laterally, and at right angles to the beak in front; 1, 2, 3, 5, Fig. 19, are copies of camera drawings of this condition in the minute germinating body; and the extremely delicate lateral points were found by close watching to develop into the lateral flagella of the perfect form. The growth was now much more rapid; Fig. 21 represents the changes that had taken place in forty minutes after the condition depicted in Fig. 20. And now slight movements began in some of the better developed forms, such as *a*, Fig. 21. They were not changes of place, but movements of the lateral and anterior flagella, and occasionally a change of the direction in which the bodies lay. In the course of another hour the neck-like protrusion at the base of the anterior flagellum generally appeared as shown in *a*, *b*, Fig. 22, and very soon—in every instance less than a quarter of an hour after—short movements of translation begin, which resulted in ten minutes more, in graceful swimming. Fig. 23 is a copy of a drawing made of one of these forms that had reached the condition the drawing depicts in a little over four hours from the time of emission from the sac. It was then the 1-8000th of an inch in long diameter, just one-half the size of the adult; but it was perfect in form, even to the possession of a nucleus, and swam with freedom and grace. Its increase of size from this time was even more rapid, for in the course of another hour it had passed through the size and condition seen in Fig. 24, to the normal parental size depicted in Fig. 25. And if, after it had reached this state, it were still persistently followed, it might be in ten or fifteen minutes, but certainly within an hour, the first signs of fission would show themselves, as indicated in *a*, *b*, *c*, *d*, Fig. 25; and from that time fission, in successively separated individuals, continued in active progress for hours, as before described.

Thus the life-cycle was completely made out.

It may be noticed:

1. That the method of fission is both delicate and complex, being not merely a separation into two parts of a particle of living protoplasm, but a division of distinct organs, such as nucleus and flagellum.

2. That the transformation of the individual form, at the terminus of a series of fissions, into an apparently new organism, prior to genetic blending (as shown in Figs. 10, 11, Plate 1), is remarkable. And

3. That the life-cycle of this form is rigid, and marked by no caprice. It passes regularly through the same metamorphoses. If seen in any given state, it could be positively affirmed through what stages it had

passed, and through what remaining stages it must subsequently pass, to reach the adult condition.

It now remained to determine whether the spore, or germinal particles, emitted by the sac, possessed any capacity to resist the action of heat not possessed by the fully developed form.

It was first carefully determined, by a method to be presently described, that the adult organism never survived after exposure for five minutes to a temperature of 142° F.

For determining the amount of heat re sistance possessed by this spore, two methods were employed:

1. The ordinary three-by-one inch slips of glass, used for microscopical purposes, were cut into three pieces, each of which was thus an inch square. These could be put into and worked with the "continuous stage." The septic fluid containing the organism was placed upon it, and covered in the usual way with the thinnest covering glass. It was then watched with suitable lenses until, either in that or in some successive drop of the fluid, a cyst was seen to pour out its spores, as in Fig. 16, Plate 2. It was then at once taken and placed in a small brass chamber, into the middle of which the bulb of a delicate thermometer was fixed, the tube fitting air-tight into the cover of the chamber, and the expansion of the mercury being read off outside.

The small square of glass containing the fluid and spores was placed, as it came from the stage of the microscope, in the middle of the chamber. The chamber was then closed, and heat so applied as to slowly raise the temperature of the air within. In half an hour it had reached the temperature I desired, which was 210° F.; and the chamber was kept accurately at this point for ten minutes.

The square of glass was then taken out, cooled and examined, and, of course, to the lens presented a dry amorphous aspect.

Previously some of the fine capillary tubes known as "vaccine tubes" had been filled with water, to which a little filtered fowl broth was added as nutriment. These tubes were then hermetically sealed, and heated up to 310° F. in a digester. These were kept in absolute alcohol, so that the outsides of the tubes might not contract dust, and so forth.

The contents of these tubes were now used to remoisten the dried film beneath the cover-glass. The ends of the tubes were broken off, and by capillarity the fluid was drawn beneath the cover, at the edge of which the now open end of one or more of the tubes was applied. In this way a plentiful supply of moisture was given.

It was now placed again in the "continuous stage" and examined. At the end of four to five hours the fluid film looked almost everywhere clear, and as it appeared before heating; but I was not able by any method I employed to discover the minute spores, nor could I find in this one the earlier stages of development; but at the end of seven hours, while "searching" with a low-angled 1-12th inch objective, I saw three forms in about the state of development shown in Fig. 23, Plate 2; and in the course of another hour a great increase in their number had taken place, and in three separate instances they were followed from the time they were first seen into full development and the commencement of fission.

When more cysts were found this entire process was again repeated twice at the same temperature, and at the expiration of ten and eleven hours respectively, adult forms in full activity were found; and in the latter of these two instances I discovered the organism when it was in the still condition of development, represented in Figs. 20 and 22, Plate 2. It was thus manifest that by this method of heating a temperature of 210° F. could be completely resisted.

Following the above process in every particular, I next, as they could be found, subjected the spores to 260° F. I did this on three glass squares (as before) in succession. But in no one of these did the organism reappear, although examination was repeatedly and carefully made for five days.

It thus appeared that a temperature of 260° F. applied in this way was fatal to the form, for, on taking a needle-point of the septic fluid containing the organism in abundance, and, touching the edge of the fluid with it, I found that in the course of four or five hours there were hundreds swimming in full vigor, showing that the fluid was capable of sustaining the organism, if it were in a vital condition in the fluid.

I next experimented at 10° F. lower, viz., 250° F. I did this on the contents of two separate cysts. In the one case, after ten hours, there was a reappearance of the living organism, but only two or three adults could be then found; and the increase that afterwards ensued was dependent upon fission, for no small forms could be seen. In the other case, there was rather a larger number of adults at the end of between nine and ten hours, but their number was far fewer than in those instances where a lower temperature had been employed.

I followed this with four more experiments, separately and successively made. Two of them were at a temperature of 248°, and two at 252° F. In both of the former, at the end of nine or ten hours, the complete organism in full vigor could be seen; and, in one of the cases, it was discovered in the still condition shown at Fig. 20, Plate 2, and watched until the organisms had attained the condition indicated in Fig. 24, Plate 2.

But in the two latter instances (heated up to 252°) the living form did not reappear during the six days following, although repeatedly looked for.

I concluded, therefore, that the temperature of 250° F. was the limit of endurance which the spore of this form could bear by this method of heating.

Now, it must be noticed that in testing the death-point of the adult, as I shall presently show, a fluid heat was employed. But the spore can hardly be said hitherto to have been heated in the same conditions. Doubtless, in the heating chamber, the higher temperatures are endured after evaporation, and consequently the heat is "dry." But, after years of thought on the matter, no other way has suggested itself to me as possible, for the attaining of the result, by other means. What is required is, that we should know beforehand, that in the drop of fluid exposed to a given heat, the spores of a given organism *in a freshly emitted condition*, and, therefore, before development had begun, were present. And, moreover, that it should be so placed that after heating it should be in such conditions as would admit of the use of the highest power lenses to discover if the spores, known to have been deposited there, would, after subjection to the thermal conditions given, develop as they had been demonstrated to do before heating.

Now, there are two ways of doing this. The one is approximate. It is by long and intimate acquaintance with the history of the organism, and a careful and close study of the condition of the fluid—by which means it is possible to come very near to the highest probability—that the spores in the required condition are there. But in this case negative results must be extremely perplexing. The other way is to see the spores actually emitted in the drop of fluid that is to be heated. This is the only certain method; it is most exhausting and laborious, but its results are certain, and therefore I have employed it in this case. But to adopt the supposition which Dr. Bastian has recently done,* that to heat a given monad spore in a given condition in a fluid is "perfectly easy," is a serious mistake. He thinks that we have nothing to do but to "put one or two drops of the fluid into a small tube * * * * hermetically seal it, and then heat it for ten minutes or more to different degrees before subjecting the fluid to a prolonged microscopical examination."

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*On the Conditions Favoring Fermentation, etc., "Linnean Soc. Jour.," Vol. XIV. This paper contains some curious inaccuracies of statement as to facts—evidently the results of misapprehension on Dr. Bastian's part—concerning the results of thermal experiments made by Dr. Drysdale and myself on the Monads. These occur on the 77th page of the paper, and will be referred to in a paper which I hope shortly to send to the Royal Microscopical Society.

Certainly this is a "perfectly easy" method; but it must fail entirely to secure the end in view. What certainty could we have that the spore—in the only useful condition for experiment—the freshly emitted state—would be in the "one or two drops?" Spores in various stages of development undoubtedly would be there. But I make no affirmation about these. There can scarcely be a doubt that germs *partly developed* must succumb at a far lower temperature. Then it follows that the certainty and the uniformity of results must depend upon the certainty we possess, as to whether the spores were in the fluid before heating or not. And when we remember that the phenomenon of fission may, in some emonads, go on in a drop of fluid under examination, as the sole method of increase for a week or more; and that, in all cases the production of the spore is extremely rare in relation to the other morphological changes, the force of this will be even more manifest.

But in thinking out the best method of determining as delicately as possible the thermal death point of the adult, it occurred to me, that having demonstrated the existence of the spore, and having watched the development after it had endured given heat conditions, that it would be possible to adopt means for comparing the differences that might exist between the destructive influence of a given temperature endured in "dry" and moist conditions respectively.

My plan was to arrange the form of the vessel in which the fluid was heated, so that without subsequent transference or exposure the fluid could be directly examined by the lens. This end was secured by means of extremely delicate glass blowing. The apparatus is presented in diagrams at Figs. 26 and 27.* In Fig. 26, A is a hollow bulb, intended as a reservoir for an infusion containing any required organism or organisms. The infusion is put in through the funnel and tube, B. The bulb, A, opens into a tube, D, on the opposite side, and this tube terminates in a delicate closed and flattened cell, C. In a microscopical point of view this cell is the most important part of the apparatus. It is a flattened bulb, and its upper and under walls are films of glass, varying in different pieces of the apparatus from the 1-50th to the 1-200th of an inch in thickness; and the space between these walls may vary from the 1-20th to the 1-100th of an inch in depth.

We thus have a perfect cell, completely closed, the contents of which can readily be studied with the aid of the most powerful lenses. The walls of the cell are, of course, not as absolutely even and smooth as the thin "covering glass" usually employed with high power lenses: but it is in the majority of cases beautifully level and clear, when the manner of its production is remembered. Of course I should never have employed these cells for the purpose of discovering delicate and unknown details; but they answer admirably for determining the presence or absence of phenomena, the nature of which is well known beforehand.

It is manifest then, that if a fluid be put in the bulb and stand at the level of the dotted line, A, that it will fill and be in communication with the cell, C.

E is a hollow bulb filled with calcined air, and hermetically sealed; but it does not communicate with the bulb, A, on account of the presence of a thin glass partition or septum, F. The object of this is, that when, by boiling, the air has been driven out of the bulb, A, and the whole interior space has been hermetically sealed at J, air may be again introduced; which is accomplished thus: H is a pointed piece of platinum wire, heavy enough by a sharp shake to break the septum, F, but too large in diameter to pass through the neck, G, but, of course, the calcined air immediately enters and restores to the fluid its normal conditions.

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*A large number of these pieces of apparatus have been made for me by a friend, an amateur. But for exquisitely finished and accurate work, I have been enabled to obtain them nowhere as they are produced by Mr. Gimingham, whose remarkable dexterity in the production of the radiometer bulbs is well known. He has from time to time made them for me, in various forms, and in a manner that leaves nothing to be desired. The principle of the apparatus is one that was adopted jointly by Dr. Drysdale and myself in the study, still proceeding, of the bacteria. But the forms of the apparatus, as described above, were made for these present investigations.

Fig. 27 is precisely the same as the above, the same letters referring to the same parts in both; but it has an addition to it marked MN. This is a tube opening at N into the bulb, A, but until needed the communication of the tube with the interior of the bulb is prevented by the thin partition, L. The object of this is, that supposing a given infusion to have become sterilized in relation to a certain organism, by any ascertained temperature, to determine whether nevertheless the fluid is still capable of *sustaining* the organism if it be reintroduced. To do this, a piece of platinum wire, as before, is taken and touched with a fluid in which the living organism abounds; it is then placed in the tube, K. The tube is then sealed at M; the piece of platinum is shaken sharply, breaks the septum, L, and falls into the fluid, inoculating it. In relation to the particular organism now being considered, this, however, was not required.

The first important matter to be taken into account was the death point of the adult. A piece of apparatus similar to Fig. 26 was used. When the fluid containing the organism was inserted, a large number of the organisms was seen by the lens in the cell, C. The whole apparatus was now placed in a copper vessel with cold water, the water just covering the bulb, A, and a thermometer was placed in the water. A Bunsen's burner was used for heating, which had minute jets springing from a tube bent in the form of a parallelogram, corresponding to the form of the vessel. The heat was now applied, so that the water rose in temperature with extreme slowness. It was taken out directly the thermometer read 100° F., and at once examined. Several of the organisms were at once visible: but the great majority of them were quite still, and the only movement discoverable was a more or less languid movement of flagella, the bodies being motionless. In seven minutes a form sailed slowly across the field, but I preferred to keep my attention fixed on those which I had seen from the first. In the course of three-quarters of an hour the flagella of ten forms were all vigorously working, and the bodies began to move, and in an hour and a half from the time of being taken out, the whole field was as active as before heating.

In the same manner the fluid was next raised to 130° F. On examination the immediate effect was more marked, the inaction more complete. Only one flagellum was seen to move in the whole field. But in the course of half an hour the flagella were gently swaying, and in two hours the same individuals were swimming freely.

When, however, the fluid was raised to 140° F., the inaction was absolute when the cell was first examined, and only one-fourth of the individuals in a selected field revived. These did so in the course of three hours, but the remainder did not move to the end of the day, and were in the same position and inactive on the morrow; and it was subsequently shown, by the same means, that a temperature of 142° F. was entirely destructive of the vitality of the adult.

The next step was to ascertain the effect of the boiling point upon the *spores*.

To be quite sure that spores, in the condition required, were in the fluid, a thin circle of glass was cut that would lie upon and take the place of the ordinary floor of the "continuous stage." By this means if a deposit of spores were seen to take place, it could be readily removed bodily from the microscope. On the under surface of this circle of glass a few lines with the diamond were made, in convenient places, to facilitate its subsequent fracture. On this then, in the stage, properly covered as usual, the fluid was hunted and watched, and fresh drops taken until a cyst was seen, and then watched until it burst. The circle of glass on which this happened was now taken carefully away from the microscope and broken, so that the pieces containing the fluid drop fell into the funnel, B, Fig. 26. The fluid containing the organism in abundance was now poured over these down the tube and into the bulb, A, carrying with it the fluid on the fragments of glass which contained the just emitted spore. Thus it was known that spores in the condition required were actually in the apparatus.

The whole was now placed in a suitable vessel with solid white paraffin, which was slowly melted, covering when in a fluid state the whole bulb, A. The heating of the paraffin was extremely gentle, and it was raised as much above the boiling point of water as was consistent with a *gentle* ebullition of the infusion, A. This was continued for ten minutes. The tube, J, was then hermetically closed before the ebullition had ceased, and was removed from the paraffin and carefully wiped while hot. The piece of platinum, H, was now shaken sharply upon the septum, F, and the calcined air contained in E was admitted into the bulb, A, the platinum remaining on the top of the passage, G, which was too small to admit of its entrance into A. In this way the normal conditions of the infusion were, as far as possible, restored.

The cell, C, was now fixed upon the stage of the microscope, and could be carefully examined with the most suitable lenses; and, from the fact that the cell was closed, "immersion" lenses could be employed, which gave an advantage in working.

I first employed an immersion 1-16th. But nothing was at all visible but Brownian movement, and during the next seven hours no trace of the organism could be found. The whole was now left for six hours more, and then the entire cell was carefully "searched" with an immersion 1-12th. At the close of an hour and a half three of the organisms, one in the adult condition, and two in the semi-developed state, shown in Fig. 24, were found swimming freely; and in the course of the next few hours the cell was freely visited by the organism in full vigor.

The length of time that elapsed before the organism appeared in the cell, I presumed to be explicable by the fact that it took a considerable time for it to arise, in sufficient quantity, in the reservoir, A, to render it probable that it would migrate into the cell, C; and this supposition was sustained by subsequent facts.

It was clear, then, that 212° F. was a temperature not destructive of the germ when endured in a fluid condition.

To reach higher temperatures it was, of course, needful to employ a digester. For this purpose tubes alone were employed, which were terminated in the cell C, Fig. 26, but the bulb, A, and all its appendages, were dispensed with; the tube, D, for example, terminating at one end in the delicate cell, C, as before, but at the opposite end in the place of A was a simple funnel for the delivery of the infusion into D. When the spore in the required condition had been found, and placed in the funnel, as before described, the fluid was inserted as before, and the tube was then hermetically sealed.

It was now placed in a small digester, with a register for pressures, and heated up to the temperature of 240° F., 10° F. below the death point in the dry condition. It was kept at this for five minutes.

As soon as it could be conveniently taken from the digester it was placed in a "cradle" on the stage of the microscope. Nothing but violent Brownian movement was visible anywhere; and nothing more than this could be seen by the end of twelve hours, although the search was very strict and systematic. For the next twenty-four hours no other result ensued, and at the end of six days there was no trace of the organism. The question now arose as to whether any incapacity to sustain the organism had been superinduced. For this purpose the tube was opened at its sealed end, and a small piece of platinum wire which had been immersed in the fluid containing the living organism was dropped into it. It was then sealed again and examined. In the course of twenty minutes seven of the introduced organisms were seen, and in the next two days they were present in great abundance.

It thus became manifest that the previous sterility of the fluid in the cell was due to the destruction of the germs, or spores, by the heat to which the infusion had been subject.

Another tube was now taken, and after preparation in all respects in the same way, was heated in the digester to 230° F., and kept at that for five minutes.

The result was precisely the same as in the preceding instance. There was no trace of the living organism from the first, on to the end of a week. But in this case, also, inoculation reintroduced it successfully, and it flourished.

I now determined that 220° F. should be tried; and after the tube and its contents had been arranged as before, it was heated to that point, and kept in that condition for five minutes.

When first examined with a suitable lens, as before, nothing but the well-known Brownian movement was visible. And this remained true for the first five hours, although the whole cell was carefully examined with the new formula 1-12th and 1-16th inch objective, and repeatedly "searched" with the 1-8th. But during the sixth hour I became convinced that the organism in a developing condition was present; it was in a part of the cell immediately under the tube; and in the course of a few minutes I was perfectly satisfied that the organism in the condition represented at Fig. 22 was there, but only five could be seen; these, however, increased in size as usual, and in the course of forty minutes three of them began gracefully to move, and following one of them I saw it attain to the usual adult condition. The next day the cell had scores of the organisms swimming in it.

This experiment was now repeated, every detail of preparation being as before. The results were similar; that is to say, the living organism reappeared; but it was not found until the seventh hour, and then it was freely swimming and in an almost perfect condition. But I could not at this time find more than this one; but in the course of some hours several more were present, perhaps as the result of fission.

From this it appeared plain that the spores had survived a temperature of 220° F. in a fluid heat: but by a series of subsequent tests conducted in precisely the same way, I found that if 220° F. might not be considered the limit of temperature which the spore could survive, at least this organism never showed itself again after heating the spore to 222° F.

It thus appears that in this particular organism the dry heat is considerably less destructive of the vitality of the spores than the moist heat. That there is, indeed, a difference of 28° or 29° F.; or, speaking broadly, we might say 30° F.

This is undoubtedly a difference of considerable importance. But a temperature of 220° F. resisted successfully at all, implies of necessity actual protection of some kind. I shall not attempt to theorize upon or suggest what that may be; but it is manifestly not beyond the reach of chemical and physical science to approximate to an explanation, whilst biological science furnishes analogy in higher and more complex departments of its researches. One thing is absolutely certain, which is, that the *optical condition* of the freshly emitted spore is quite distinct from that which it presents in from three-quarters of an hour to an hour after development has commenced. It is to the comparative opacity of the newly emitted germs that their visibility at that time is due. Hence they are most certainly discovered by means of a shaft of almost parallel light the 1-100th of an inch in diameter at right angles to the plane on which the spores are lying, and their imperfect transmission of this reveals them. But in the course of an hour they become far more transparent than even the adult form. This is undoubtedly the result of the vital processes involved in germination. The sarcode is in a fluid condition and cannot resist the heat that surrounds it—a constant current of liquid must be passing in and out of the sarcode by imbibition and exosmosis. The result must be the circulation through the sarcode of fluid at a temperature destructive of the vital processes. Hence the destruction of the adult at 142° F., and there can be little doubt but the young germinating form would be destroyed, for the same reasons, at the same, or—perhaps from the probably greater intensity of the vital processes—even a lower temperature. But in the spore, the vital activities of the developing protoplasm have not commenced; the sarcode is in all probability in a fixed state; and a protective condition of that sarcode, resisting the diffusion of heat through it, is by no means difficult to understand. Indeed it will be palpably of service to the organisms, and, like desiccation, enable them to overcome the extreme vicissitudes of condition in temperature, drought, and so forth, to which over the surface of the earth, they must, as septic organisms, be exposed. But from a series of experiments on the spore of such of the "monads" whose Life-Histories were worked out by Dr. Drysdale and myself, as I have been enabled to get again during the last two years, I have been able to satisfy myself that 30° F. is by no means the fixed difference between the power of thermal resistance possessed by the spores of these forms when heated in a dry and a moist condition. There is considerable variety in this matter, and variety which, in all probability, nothing but a perfect acquaintance with the vicissitudes through which by adaptation they have survived in their evolutional history, could explain.

In conclusion, without entering into details, I may observe that these forms have, as far as my observations have extended, a far greater capacity to resist heat than the bacteria; but their distribution is far more limited.

[The plates, of which a description is given below, are numbers 8 and 9 in the original. We have numbered them 1 and 2 of the present volume of the AMERICAN JOURNAL OF MICROSCOPY.—ED. AM. J. M.]

DESCRIPTION OF PLATES.

Plates 1 and 2.

Fig. 1. The normal form of the organism described; *d* being the nucleus.

Fig. 2. The representation of the mode in which it appears by mechanical means to break up the decomposing tissues of the animal matter in the maceration. *a*, *b*, are points at which its lateral flagella are "anchored;" it then draws its body down, coiling the flagella into spirals seen at *c*; it then springs up and forward in the direction of the arrow, *d*, and with the flagella as a radius darts rapidly down upon a piece of tissue in the arc of a circle, shown by the arrow, *e*.

Fig. 3. The first indications of fission are seen at *a*, *b*, and the nucleus has moved to the centre.

Fig. 4. Fission is in progress, as seen at *a* and *c*, and in the nucleus, *b*.

Fig. 5. It is still progressing; a pale line runs through the dividing body, and the nucleus has separated.

Fig. 6. Fission still further advanced.

Fig. 7. Only a neck of sarcode now unites the bodies; this is sharply pulled, and results in a thin fibre connecting two forms, as seen in Fig. 8.

Fig. 9. This has stretched as here drawn; the bodies pulling in the direction of the arrows, until the fibre snaps in the middle, and two perfect forms go free.

Fig. 10. At the terminus of a series of fissions in about a third of the cases, the body becomes changed, slow of movement, and amœboid, as here drawn; and then rapidly changes into the shape seen in Fig. 11.

Fig. 12. The form shown at Fig. 11, after forming a band seen at *a*, goes into the midst of a group in the "springing" state, and speedily unites itself to one, which at once goes free; and they swim together as in this figure.

Figs. 13, 14, 15, 16, 17. Represent different progressive stages of fusion, which terminate in a still sac (15), which ultimately opens and pours out spores (16, 17).

Figs. 18–25. Different progressive stages in the growth of the emitted spores.

Fig. 26. A piece of glass apparatus for testing the thermal death point of the adult, and for discovering whether or not the boiling point in a fluid detroys the germ. The cell, *c*, enables this to be determined by microscopical examination directly, without any transference of the infusion; and the bulb, E, being filled with calcined air, enables the experimenter, when the whole piece of apparatus is closed at J, to restore air to the bulb, A, containing the infusion, by breaking the thin septum, F, by means of the comparatively heavy piece of platinum, H, which opens a communication between E and A.

Fig. 27. Is the same as the above, except for the added tube, MN. This is intended to be used if the fluid should prove to be sterilized, for the purpose of inoculating it again by means of a piece of platinum, which is charged with the fluid in which the organism is abounding. This is introduced into the tube, which is at once closed at M. It is then made to break the septum, L, and falls into the fluid inoculating it, to discover if it still has the power to sustain the organism.

All the drawings of the organism are magnified 3,000 diameters, except where otherwise indicated on the plates.

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Microscopical Research.

It is a singular fact, but it is not the less a true one, that there is no country in the world where excellent microscopes can be had cheaper, and yet where there is less good work done with them than England. A great deal may be said, doubtless, on the high value of the immersion lenses now so much employed on the Continent, and manufactured on so large a scale by Hartnack, of Paris, and Merz, of Munich. But if the immersion system proves, as it is likely to do, one calculated to meet the wants of the investigator, we shall be able to surpass the French and Germans, even in the manufacture of this form of objective. And, in so far as the ordinary dry lenses are concerned, we do not hesitate to affirm that there are no manufacturers, whether Continental or American, who can stand in competition in work of this kind with our English makers. There are, we know, a few who go into ecstasies over Nachet's "stands," but we have seen these instruments, and can honestly say that they have nothing in their favor but their great weight; and, for durability, solidity, and beauty of workmanship, we should not think for a moment of comparing them with the stands of our best London makers. Differences of opinion may exist on this, as on all other points, and we shall be very glad to hear the views of our numerous correspondents on the subject. But we believe that the great bulk of those who have experience in the microscopes of different countries, will admit the force of the proposition with which we started, that English microscopes, taken *tout entier*, surpass those of every other nation.

How is it, then, we ask, that with such excellent appliances so little good work is done annually in England? Is it that the number of those who possess microscopes is so limited, or is it that the instrument is used "in a groove" by persons who have never been taught the wide field for exploration which lies before them, and who are ignorant of the methods of microscopical inquiry? The former question can, we think, at once be answered in the negative. A visit to any of the soirees of the Royal Microscopical Society or Quekett Club, or to the houses of our first-class opticians, will demonstrate in a very few moments the fact that the microscope is an instrument having an extensive sale, and that it is largely distributed among all classes, and is much used by those who purchase it. It cannot be then that the microscope is not in the hands of persons who are interested in testing its capacities, and therefore we are bound to fall back on the alternative explanation that the absence of important research—or rather of the due proportion of scientific investigation—is owing to the circumstance that the thousands of earnest and industrious people who possess good microscopes have never yet been taught in what direction to turn their labors.

Go where we will among microscopists, we unhappily find that the rage for perpetually poring over diatomaceæ is nearly universally epidemic. Men with the best instruments and most perfect and elaborate appliances for scientific inquiry, spend their hours in, we won't say fruitless, but certainly in unprofitable exertions to bring out the markings in an *angulatum* or a *rhomboides*, just as if the only thing to be done with so useful a means of research as the microscope undoubtedly is, was to discover how many lines on a minute vegetable structure could be brought into view. There was a time when such inquiries were useful, as they stimulated the manufacturer to bring his lenses up to that degree of optical perfection which entirely, or nearly so, avoided aberrations. But assuredly the present optical perfection of the microscope, so close as it is to theoretical possibilities, is all-sufficient for biologists, and it is melancholy to waste time in attempts of the kind, while so much important biological research awaits the ardent student. And, indeed, it is to be observed, *en parenthèse*, that the very optical imperfections which some *diatomaniacs* would seek to remove, are those most valuable in anatomical studies. Definition is an excellent quality, but it is not paramount; and for the worker the mean between the highest "definition" and the greatest "penetration" is what is required.

We make these remarks in the hope that some of our older workers with the microscope may be induced to come forward and give advice to the large field of amateur laborers who are now doing just that kind of useless work which is known to seamen as "scraping the cable." What we should like to see would be the delivery of a course of lectures "on the work to be done with the microscope," by some master in biological inquiry. If some one like Professor Huxley would come forward and give "a working man's lecture" on the multitude of important points to be made out by means of the microscope, we believe he would do more than has been achieved for years to advance histological research in these countries. The man who has a microscope wants to be led out of the manufacturer's groove of "diatoms" into the field of physiology. He requires to be shown what an area for observation and thought would be opened to him in the study, say, of the embryology of even the simplest and commonest forms of life. Will no one take up this good office and discharge it faithfully and thoroughly?—*Scientific Opinion, June* 2, 1869.

Notes on Century III of the "Species Typicæ Diatomacearum," by Prof. H. L. Smith, Geneva, N. Y.

No. 201. *Hyalodiscus subtilis*, Bailey. This is the *Craspedodiscus Franklini* of E. And it was also distributed by Bailey, with the manuscript name *H. Californicus*. Grunow states that it is so nearly allied to *Podosira hormoides* of U. S., that it is impossible to define the difference, and proposes the name *P. Franklini*. Mr. Kitton doubts whether the present form is Bailey's species, inasmuch as the umbilicus is larger (half the diameter of the valve) than Bailey's figure shows it, but in this respect it appears to be variable; in some specimens the umbilicus is one-third, and in others fully one-half, the diameter of the valve, and occasionally even more. The markings of this diatom were first detected by Prof. Bailey in 1842, and at this time it was a severe test for the best objectives, and, in fact only to be resolved by use of sunlight.

No. 202. *Hyalodiscus obtusangula*, K. This is an insignificant diatom, but the specimen is from Kutzing's original.

No. 205. *Isthmia minima*, Harv. et Bail. This form, though showing club-shaped corpuscles, not figured by Bailey and Harvey, in their representation of *I. minima*, and which indeed are not very distinctly perceptible in balsam, unless one is looking closely, has for a long time been considered by American microscopists as Bailey's *I. minima*, and has been distributed under this name. Herr Grunow, in his paper on "New Diatoms from Honduras," published in the *Monthly Microscopical Journal*, October, 1877, describes it as a new species under the name *I. Lindigiana*. He likens it to a variety of *I. enervis*, inhabiting the southern seas, and which he calls *I. capensis*, but differing from *I. Lindigiana*, in not having the peculiar club-shaped corpuscles. Mr. Kitton, in his notes to Herr Grunow's paper, suggests that *I. capensis* is perhaps the *I. minima* of Bailey and Harvey. As I have not been able to find Bailey's original specimens, it must still remain in doubt whether his form and Grunow's *I. Lindigiana* are, as I had hitherto supposed, identical.

207. *Lauderia annulata.* This is the only species of a genus named in honor of Mr. Lauder, well known for his contributions to the history of the *Chætocereæ;* it is closely allied to *Melosira;* the short hair-like processes, or spines, on the valves, remind one also of *Cresswellia.* Many of the *Melosireæ* have marginal spines, and often on the valves, *e. g. M. crenulata* and *M. Roseana.* The annulate character of the frustules of the present genus, in f. v., is considered by Prof. Cleve of sufficient value to constitute a new genus. The gathering in which this form occurs has many other objects of interest, *e. g. Melosira costata,* Grev., *Asterionella Synedræformis,* Grev., *Chætoceros Lorenzianum, Bacteriastrum, Eucampia,* and occasionally *Molleria cornuta,* Cleve, which resembles *Striatella,* but has the extremities of the valves produced in blunt processes.

No. 208, *Licmophora argentescens,* Ag., and No. 209, *Licmophora splendida,* Grev. For an almost exhaustive paper on the genus *Licmophora,* see Mr. Roper's contribution, published in Vol. III, N. S., pp. 53 et seq., Mic. Trans. London. After examination of authentic specimens of Agardh and Kutzing, he states that he is unable to determine whether there should be two, or only one species, a remark which will be appreciated on examination of the two forms in this series. Prof. W. Smith, in the "Brit. Diatomaceæ," Vol. I., p. 85, states that he is far from being decided that the two forms which he describes are distinct. No. 208 of the present series was sent to me by Grunow, as *L. argentescens* of Agardh; it is the *L. splendida* of W. Smith. The frustules in f. v. are more narrow than in No. 209, which is the *L. flabellata* of W. Smith, not *L. splendida,* Grev. For this gathering I am indebted to Major Lang, who found it in abundance at Torquay, Eng. I have never been able to obtain good specimens of this, or *L. argentescens,* on our Atlantic coast, neither has it occurred among any of the algæ that I have seen from the California coast.

No. 210. *Liparogyra spiralis,* E. This rare form, after many years search, was finally secured for me by Mr. Kitton, and I have never seen any other gathering. Grunow is disposed to consider it as a variety of *M. roseana;* it seems to me quite distinct.

No. 213. *Mastogloia Jelineckiana,* Grun. This diatom will be recognized easily by its rhomboidal outline; it was first described by Grunow as a *Navicula.*

No. 226. *Melosira lineata,* Dill. Scarcely different from *M. varians,* but it seems to have been separated as a marine form.

No. 228. *Melosira orichalcea,* Ralfs. This is the *Orthosira orichalcea* of W. Smith, from the Premnay peat; he gives as synonym *M. Italica,* and var., *M. crenulata.* He may be right, but a comparison with No. 220, which is the *M. crenulata* of K., shows the latter to be somewhat less robust, and not as delicately marked; probably they are the same.

No. 230. *Melosira sculpta,* E. This is not the form first described by Ehrenberg under this name, and which will be found in the Oregon deposit, No. 58, of this series, but it is the form figured under this name in his latest contribution, on "Bacillariæ from California," Berlin, 1870. Ehrenberg's figure shows distinctly the marginal teeth. Interspersed among the valves will be found some curiously marked "Secondary plates," with stellate centre, and a broad marginal ring, which is strongly rayed, and also with five or more strongly defined ribs, or blank spaces, not reaching the margin, which is itself decidedly serrate.

No. 237. *Meridion constrictum,* var. This singular variety, by alternate inversion of the frustules, forms a straight filament instead of the ordinary circular one. Occasionally the cuneate form of the frustule is preserved. It appears at first to be an *Odontidium,* but is distinguished by the alternate arrangement of the vittæ, or enlarged bead-like dots, now on one end, now on the other of the frustules, showing that it is composed of frustules alternately inverted; frequently the alternation or inversion occurs in one frustule, the "bead" being at top on one edge, and at bottom on the other edge of the same frustule, whereas in *Odontidium*, two beads are to be seen on each end of the frustules. For many years I found this form regularly occurring in a pool, made by the spring rains, and which was thoroughly dried and baked on the bottom during the summer and fall; the growth was often excessive, and the long waving filaments, very noticeable in the little stream which discharged the surplus water, scarcely any other diatom being present. The regular occurrence of this form in early spring for several years, in the same place, and its appearance nowhere else in any of the ponds or ditches of the neighborhood, or in the river even, into which the water from the ditch eventually escaped, is a suggestive fact, and appears to indicate what, indeed, has long been suspected, that to a certain extent the diatomaceæ may bury themselves in the moist earth, and even undergo partial desiccation, when the ponds dry up, and after a definite lapse of time, under influence of moisture and spring temperature, may again make their appearance, and rapidly increase by the ordinary mode of deduplication. Whether the conjugating frustules which in this form, as in Meridion, are the peculiar variety with internal siliceous walls (known as *M. Zinckenii* in the case of *Meridion*, and as *H. Solerolii* in the case of *Himantidium*) or the sporangial frustules, which in *Meridion* are quite irregularly shaped, and sometimes double the length of the parent frustules, are the ones that survive, cannot yet be decided.

No. 238. *Meridion intermedium*, H. L. S. This is the only gathering I have seen of a transitional form, leading from true Meridion to No. 239, the position of which has long been doubtful; the crenulations, usually so strong on the margin of *Meridion* in f. v., and the pervious costæ or ribs in s. v., are scarcely to be discerned. The preparation here given is in its natural condition, *i. e.* untreated with acids, as are all the preparations of this series when possible.

No. 239. *Meridion erinaceum*. This form, first detected by Brebisson, and named *Gomphonema fibula*, and afterwards by Breb. and Arnott *Peronia erinacea*, is in habit precisely like *Meridion*, and with exception of being much smaller, and more slender, is quite like No. 238, with its front markings obliterated.

No. 241. This is the *Frustulia acrosphæria* of Brebisson, but not the *Navicula acrosphæria* of Kutz. It was called *N. punctata* by Dr. Arnott. To avoid confusion, Brebisson accepted Arnott's name. After all, it is probably only a variety of *N. tabelleria;* it occurs in the Premnay peat, No. 228.

No. 247. *Navicula Anglica*, Ralfs. This is the *N. tumida* of W. Smith, but as the latter name had already been given by Brebisson to what W. Smith calls *N. Jenneri*, as indeed is stated in the "Synopsis," Mr. Ralfs very properly relegated Brebisson's name to the form to which it was first given, and so was obliged to call Smith's form, or the present series, another name, *N. Anglica*.

No. 249. *Navicula apiculata*, Breb. I suppose this to be Brebisson's *N. apiculata;* it occurs in a gathering received from him, but unlabeled; it agrees well enough with his description and figure. It is not Gregory's form, figured in the *Mic. Journal*, Vol. IV., pl. i, f. 13, which is called *N. rostellum* by W. Smith in Vol. II of the Brit. Diatomaceæ.

No. 251. *Navicula biceps*, E. This is not the *Pinnularia biceps* of Gregory, which is No. 285 of this series, but is figured by Kutzing (copied from Ehrenberg) in Bac. T. xxviii, f. 51. It is small, turgid, lanceolate, with obtuse conical or capitate apices, striæ indistinct.

No. 253. *Navicula Boeckii*. This form, which is described by W. Smith in the "British Diatomaceæ" as a *Doryphora*, and by Kutzing as a *Cocconema*, is a stipitate *Navicula*. It has the peculiar elongated central blank (or nodule) characteristic of several of the frondose, or strongly mucous-secreting *Naviculæ*, e. g. *Schizonema Dillwyni*, *Colletonema vulgare*, and *Frustulia Saxonica*.

No. 255. *Navicula Carassius*, E. This is a small form, and is from Brebisson's collection. The valve is inflated, constricted at the ends into short conical apices, striæ quite distinct. In the same gathering is the *Cymbella amphicephala*, Naeg., and *Stauroneis Smithii*=*S. lineata*, W. S.

No. 256. *Navicula cincta*, E., is a minute form, valves slender, lanceolate, with prominent end nodules, and with easily resolved, somewhat radiant, striation.

No. 258. *Navicula convexa*, W. S. This is the *Scoliopleura convexa* of Grunow. The genus was constituted by him to receive *Naviculoid* forms with twisted sutures in f. v., and of raphe in s. v. Mr. Kitton says that this diatom is the *Amphiprora latestriata* of Brebisson; it seems scarcely credible, but he has examined authentic specimens. Associated with this form in the present gathering, are numerous valves of *Cyclotella Dallassiana*, and less frequently the *Navicula interpuncta* of Lewis.

No. 259. This is Brebisson's own specimen of *Navicula Crassinervis*, and labeled by him; an examination of this form will remove any doubt of its identity with the so-called *Frustulia Saxonica*, and a comparison with *Colletonema vulgare* will show its close affinity to that, and finally, in the slide of *Frustulia Saxonica*, will be found many specimens passing into *N. Rhomboides*. Castracane, from his photographs, pronounces decidedly against the idea that these are varieties of the same species, but it all depends upon what one accepts as the proper limit for species. Brebisson has proposed to group all these allied forms under one genus, "*Van Heurckia.*"

No. 272. *Navicula esox*, E. Probably only a variety of *N. permayna* of Bailey, with undulate outline.

No. 276. This is a variety of *N. Cohnii*=*Stauroneis Cohnii*, Bleisch. Dr. Arnott considered it as the *Nav. mutica* of Kutzing. *Nav. Cohnii*, normal form is rather smaller, and with more rounded ends; the characteristic feature is the very prominent and somewhat quadrate central nodule.

No. 280. *Navicula Hartleyana*, Grev. This is the original, which Rev. Mr. Hartley sent to me from Cavalla, and also to Dr. Greville. It is another case where a finer striation has been considered sufficient to warrant naming as a new species.

No. 286. *Navicula Johnsonii*, W. S. This is the *N. Scopulorum* of Brebisson. It is a slender and delicate form, of a pale straw color when dry. Occasionally it occurs somewhat more robust than in the present gathering; then again, in the gatherings from the Watermouth Caverns it is narrower and paler in color; a very curious variety, enlarged at one end, like *Gomphonema;* occurs in the marshes near Savannah, Ga.

No. 287. *Navicula Kutzingiana*, H. L. S. This form, which appears to be abundant in Brebisson's collection, was labeled by him as *Amphiprora arenaria*. However appropriate this name might have been at a time when it was given to forms having nodules within the margin in f. v., it does not now belong to the group recognized as *Amphiproreæ*, and as there is already a *Nav. arenaria*, I give to this form the name of the veteran algologist, Kutzing.

No. 293. *Navicula maculata*, Edwards. This form was first figured by Bailey as *Stauroneis maculata*. Subsequently Dr. Greville figured it as *Navicula Johnsoniana*, and it was issued under this name in slides from the Essex Institute.

No. 299. *Navicula oculata*. A very small form with prominent central nodule.

A Microscopical Cabinet.

AT a recent meeting of the San Francisco Microscopical Society, Dr. Monser described a very convenient microscopical cabinet, which he had devised. It consists of a lower and upper portion. The lower portion, four feet long, is arranged like many table desks, having a horizontal top two feet four inches above the floor, an open space running clear through beneath to give room for the legs in sitting, and beneath, on both sides of this, instead of the usual drawers or pigeon holes, two doors open on two tiers of trays for slides. Beneath the trays, are two drawers, three inches deep. Above the central open space, but beneath the top of this desk, a shallow drawer opens out over the lap, and at each end of the desk are doors opening upon closets back of the trays, which will contain any microscope case, and may also be used for lamps and general stores. Thus the lower portion contains two closets, two tiers of fifty-six trays, and five shallow drawers. Fastened upon this is the upper portion, a little less in length, and receding in front about five inches. This portion encloses a clear central space in which the microscope constantly remains, enclosed by folding doors—two in front and one at the top, when not in use. This open space, twenty-two inches wide, conveniently admits the arms in working, and is enclosed behind by plate glass (the back of the cabinet is supposed to be placed before a window), to admit light, in front by the two folding doors, and above by the one falling and rising door already mentioned. This uses up one-half of the upper portion. The remaining two quarters, on either side of the working space, are closed before, behind, at the ends and top, but open into the central space. The left division contains fourteen drawers, which pull out into the open space, and the right hand one contains three shelves for bottles, etc. The shelves and drawers are just 11 inches deep. The upper portion is 2 feet high, making the total height 4 feet 4 inches, and is 22 inches deep. The whole contrivance has many advantages; work may be hastily left by simply shutting in the instruments, slides, etc., with the top and front doors. Sitting at it, everything can be reached without moving; and material and apparatus, instead of being scattered here and there, are all in one place. Tastefully and solidly made of black walnut, the whole cabinet costs about $100.

Balsam Mounts.

BY F. M. HAMLIN, M. D.

THE condition of several balsam mounts which I have seen lately, induces me to offer some suggestions for their better preparation.

Balsam mounts are regarded as the most permanent of all, but are liable to changes caused by evaporation of the more volatile portions of the balsam. This produces a vacuum, and the air forces its way in, in the form of bubbles, cracks, etc., and finally the balsam becomes so dry and brittle that a slight blow or shock will cause the cover to fly off. As I write, I have before me a box of six slides belonging to the American Micro-Postal Cabinet Club, and of these four are more or less affected, from a few bubbles just at the edge of the cover to the invasion of more than half of the area of the cover. Besides looking badly, their value is decidedly impaired. The remaining two are as neat and perfect as the day they were finished, and are good for an indefinite period yet. I have adopted a similar plan of finishing for some time, and find it requires no great outlay of time or labor. I clean away all the balsam which exudes when the cover is pressed into place, except enough to fill the angle formed by the edge of the cover and slide, and present a sloping surface. When this hardens, I put the slide on my turn-table, and run a ring of gold size around the edge of the cover, of course having taken the precaution to "centre" the object when first mounted. The object in using gold size is that if admixture between it and the balsam takes place, no discoloration results, but asphalt and white zinc will mingle and spoil the mount. After the gold size hardens, the ring may be finished as fancy dictates. I sometimes put on a ring of white zinc, and run on a delicate ring of some bright color at the outer and inner edge of the white zinc.

If dispatch is required, bleached shellac dissolved in alcohol may be used for the first ring, as soon as the color adheres enough to bear the slight touch of the brush, and then finish as before.

The time expended is amply repaid by the improved appearance of one's cabinet, and durability secured.

The Postal Club slides are not the only ones which suffer, for I have in my cabinet some not put up over two years, which were decidedly injured by evaporation. I remedy the trouble by dropping turpentine to the edge of the cover. This soon is drawn in, and when the holes are all filled I put some fresh balsam in place of the turpentine, and as the evaporation takes place again, it flows in and fills up the old air spaces. By this means and a little patience, I have saved several valuable slides.

Collection of Canada Balsam.

THIS article is largely collected in the Province of Quebec, where the *abies balsamea* grows in great abundance. It is gathered there, not only in quantities sufficient to supply the needs of the Dominion, but also to export to a sufficient extent to form an important article of commeree. The writer is indebted to the kindness of Mr. W. E. Brunet, chemist, of Quebec, who is a large dealer in this balsam, for the following details in reference to the collecting of it:

The whole family of balsam gatherers go into the woods in the Laurentine Mountains, at a distance of from seven to ten miles from the villages. There they encamp for two months, their baggage consisting of canisters, packages of pork, flour, a stove and bed covering. The mother remains in the camp to do the cooking and to strain the gum, and it is she who transports it, upon her back, in canisters of five gallons each, to the village, where she sells it at the rate of $1.20 a gallon in exchange for flour and pork, which, on her return, she carries also on her back to the camp. The father, with his boys, goes to pierce the trees, each furnished with a small can with a tube proceeding from it at the top. This tube is of iron, sharpened, and with this portion of the instrument the blisters of gum are pierced, one by one, the liquid flowing down the tube until the vessel is full. The children mount into the branches, while the father works about the lower part of the tree. A large balsam tree, rich, in gum, will yield as much as a pound of balsam; but, one with another, the yield of each tree is not usually more than eight ounces. The father, with the help of two children, can gather from sunrise to sunset a gallon of balsam, but the man who works alone has done a good day's work when he has collected half a gallon.

One cannot gather the balsam when it rains, or even on the same day, for the branches let fall drops of water, which, mixing with the gum, render it milky and unsaleable. The collection of the balsam is made from the 15th of June, or about the time that the snow disappears from the mountains, up to the 15th of August or 1st of September, the date when the snow usually begins to fall, or the weather turns cold and the gum no longer flows. Near the villages and upon partially cleared land it is gathered in May, but this is only in small quantities. It is only the poorest inhabitants and the Indians who do this business. There has been gathered in the mountains nearly 3,000 gallons this year; the largest crop ever gathered was 5,000 gallons. A tree should not be pierced two years running, and requires two or three years' rest before being tapped again, and then it always yields very much less than the first time.

Spirit of turpentine and resin were made in Canada during the time of the civil war in the United States, when prices ruled high. They were prepared from the common red pine, *Piuus resinosa*, which grows in abundance in the northern counties of Ontario. The turpentine obtained from this source, although not identical with that made from the *Pinus palustris* and other pines of the South, yet served as a convenient substitute in the various uses to which that article is applied in the arts. At the close of the war, when Southern turpentine resumed its old figures, this manufacture in Canada was abandoned, because it was found impossible to produce it at a price to compete with that from the South.—*Trans. Am. Pharmaceutical Ass'n.*

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Terms—$1.00 per year.
Advertisements—30 cents per line.
All Communications should be addressed to
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Important Notice.

We can no longer supply complete sets of Volume I in sheets, but offer all the numbers except Nos. 1, 4 and 8 for 25 cents, by mail, postpaid. We have on hand a few complete copies of Volume I, handsomely bound in cloth, with gilt title, price $1.25. Volume II, in numbers, is also exhausted, but we can supply fresh clean copies, with large margin, bound uniformly with Volume I, for $1.25.

As we desire to place a COMPLETE set of the Journal at the disposal of our subscribers at a moderate rate, We offer Vols. I and II, bound, and Vol. III in numbers as issued, for $2 50 *net*. These who wish to have their numbers of either Vol. I or Vol. II bound can do so for 35 cents. Postage 10 cents additional.

Foreign Subscribers.—Subscribers in Great Britain and the Continent of Europe will be supplied at the rate of $1 20, or 5 shillings sterling per year, postage paid. Five copies will be sent for £1. British postage stamps received for single subscriptions. Volumes I and II, bound, will be sent for 5 shillings each, postpaid.

The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

Mr. Charles Stodder, 131 Devonshire Street, Boston.
S. E. Cassino, Naturalists' Agency, Salem, Mass.
J. G. Langguth, Optician, 48 Madison St., Chicago, Ill.
James W. Queen & Co., 924 Chestnut St., Philadelphia.
W. H. Walmsley, 921 Chestnut Street, Philadelphia.
Fred. Wagner, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the American Journal of Microscopy. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

The January Number.

THE number of the American Journal of Microscopy for January, 1878, is entirely out of print, and we can no longer supply it to subscribers.

We will gladly pay ten cents apiece for clean copies of the American Journal of Microscopy for January, 1878.

Correction.

IN our last issue we stated that the letter from Rev. Dr. Dallinger was addressed to Mr. Chas. Stodder, of Boston. This was a mistake, for which we are wholly responsible. It matters little, however, to whom the letter was addressed; it contains information of great value to every worker in the higher departments of microscopy.

The American Society of Microscopy.

THE recent National Microscopical Congress closed its sessions by the organization of a permanent society, which has chosen for its name "The American Society of Microscopy." That this name is eminently appropriate to the society now organized must be evident to every one, and therefore it is greatly to be regretted that a local society should have chosen a name so nearly like this that comparison must be the inevitable consequence.

The nature of the permanent organization which has been effected is shown in the following constitution:

Name—The American Society of Microscopy.

Object—The encouragement of microscopical research in all branches of science.

Membership—Any person interested in microscopical research is eligible for membership.

Officers—Shall consist of a president, vice-president, secretary and treasurer, holding office for one year, or until successors are qualified.

Executive Board—Shall consist of the officers of the society and the past presidents, with three members elected from the society.

Meeting—The place of meeting shall be determined annually, as time and election of officers.

Election of Officers—Shall be elected by ballot, without nomination, and all votes cast be necessary to a choice.

Duties—Shall be the same as in similar organizations. The president to deliver an address at the opening of the session.

Fees—Dues shall be $2; initiation fee shall be $3.

The election of officers was proceeded with, and resulted as follows: President, Dr. R. H. Ward, Troy, N. Y. Vice-Presidents—S. W. Dennis, San Francisco, Cal.; C. M. Vorce, Cleveland, O.; Dr. Blackham, Dunkirk, N. Y. Secretary, Dr. Henry

Jameson, Indianapolis, Ind. Treasurer, H. F. Atwood, Chicago.

It was determined that the meeting of the association in August, 1879, be held at Buffalo, N. Y., and that an attendance of twenty-five members constitute a quorum.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New Jersey Microscopical Society.—This Society held its eighth anniversary in the Geological Hall of Rutgers College, New Brunswick, May 27, at 7 P. M. The occasion brought together an intelligent audience, which filled the large lecture room. After disposing of the routine business, by programme limited to 30 minutes, the President. Prof. F. C. Van Dyck, delivered the annual address; subject, "The Progress and Status of Microscopy." It contained a clear statement of some of the capacities of the modern microscope, and some thoughts on the future instrument, when improved machinery and perfected formulæ would cheapen the making of the lenses, and thus increase the number of workers in the field. This was followed with a paper by the Secretary, Prof. S. Lockwood; subject, "A Biography of Cimbex Americana." The paper was amply illustrated with specimens of this giant saw-fly, and slides showing a part of its anatomy. In the preparation of his subject, the Secretary had hatched 180 specimens in his study. Among the points presented were: 1. The separate duration of the larval and the pupal states. The larva or grub hibernates in the cocoon, thus spending some eight months as a larva; then taking on the pupa form for a few days, before the imago appears, this period, according to temperature, being in some cases only seven days. 2. The males, as a rule, assume the imago state before the females. Of nearly 200 cocoons, the first half that hatched were nearly all males, the exception being 3 or 4 females to 86 males; the remaining 90 were females, except some 5 or 6. 3. The emergence from the leathery cocoon was shown to be effected by a rotary cutting off of a cup-like segment, and not by a pushing off o' a lid loosened by moisture. This cutting was demonstrated by the microscope, several slides showing specimens. The reader showed the same result in insect eggs of very minute size; and also exhibited the nest of the California tarantula, and the belief, with reasons, was expressed that the lid in this case was loosened by cutting. 4. Slides showing preparations of the saw, and ovijorites were exhibited, and it was stated that the growth of the teeth was kept up by the presence of a large artery which supplied smaller branches to these organs. The paper will doubtless be published.

After this there was a general exhibition of slides by the members, to which the audience were invited. Dr. Morrogh exhibited the circulation of blood in a frog. Mr. L. H. Noe illustrated the cause of the velvet aspect of the petal of a geranium. Prof. Van Dyck showed under the polariscope crystals of urates from the caterpillar of Empretia stimulea. Prof. McClosky, of Princeton, showed the poison glands of Rhus toxicodendron; also a fine slide of the notochord of the lamprey.

The Secretary used two microscopes, showing slides illustrating his paper, one of which was a new Professional microscope by Geo. Wale, which gave fine results. The above are but a few of the objects shown to the visitors.

At the election, which was a part of the routine business, Prof. F. C. Van Dyck, of New Brunswick, was re-elected President, and Prof. Samuel Lockwsod, of Freehold, N. J., was elected Recording Secretary and Treasurer.

S. LOCKWOOD, Secretary.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, June 20, President Hyde in the chair. Mr. J. A. Crane, of Iowa, was the visitor of the evening.

A number of interesting additions to the Library and Cabinet were announced, among them, by donation from Mr. J. B. T. Tuthill, Campylodiscus, Navicula, Surirella, etc., from Santa Cruz, and other diatoms from Monterey, all in balsam; by exchange with M. A. Booth, Tabellaria flocculosa and Fragilaria virescens, from Long Meadow, Mass.; from the Secretary of the Belgian Microscopical Society, three parts of their proceedings; and by purchase, "Optique Physiologique, par Helmholz;" Parts 5, 6, 7 and 8 of "Icones Selectæ Hymenomyctum nondum delineatorum," and the current numbers of "Grevillea," "Flora," "Popular Science Monthly Supplement," "Science Gossip," and "Nature."

A letter from Prof. Cleve, of Sweden, expressed thanks for the valuable contribution of Pacific Coast diatom earths from the Society, and promised in return some interesting slides or diatoms. Another letter was from the illustrious Prof. Haeckel, of Jena, acknowledging his election as corresponding member by the Society, and enclosing a paper by him on the "Alternate Generation of the Echinoderms."

President Hyde proposed a plan for giving topics for discussion to each meeting, and the matter was put in form by a motion by Dr. Whitney, that "a subject shall be announced for consideration at the following meeting, and that at such subsequent meeting the subject announced shall be brought up for discussion and consideration as a part of the order of business, to follow written communications."

After selecting as topic for the next meeting, "The Microscopical Examination of Sea-Water, with Respect to its Animal and Vegetable Life," the members listened with interest to the extended remarks of Dr. Whitney on the "Beginnings of Life," which caused some discussion.

The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, Aug. 1, at the Society's rooms, President Hyde in the chair. Mr. John Haly, of Los Angeles, was a guest of the evening.

The Secretary announced an increase in the library by the donation, from the author, Rev. W. H. Dallinger, of a paper on "The Life-History of a Minute Septic Organism," and by subscription the current numbers of AMERICAN JOURNAL OF MICROSCOPY, "English Mechanic," "Flora," "Science Gossip," "Popular Science Monthly," "Nature," and parts IV and V of the "Ferns of North America." The system of exchanges inaugurated by Mr. Clark seemed to be productive of good results, even at so early a date, there being placed upon the table diatomaceous material from Dolgelly, Ireland; Jutland, Scotland, Germany, and other famous deposits in Great Britain and on the Continent, to the number of twenty. The spicules of three different gorgonias, fossil black moss, etc., were also received. It is greatly to be hoped, in the interests of both the science and the industry of this coast, that those members of this society, who have made a special study of the Diatomaceæ, will thoroughly investigate the numerous Pacific Coast deposits, now being sent abroad in exchange, with reference to their geology, distribution, origin and commercial value, as well as to the contained species.

President Hyde spoke of the coming National Microscopical Congress at Indianapolis, Ind., and, upon motion, Mr. Dennis was appointed delegate from the society to that Congress, with urgent instructions to secure, if possible, the next annual meeting of the Congress for San Francisco, it being understood that the C. P. R. R. would grant reduced rates to delegates.

Dr. F. H. Engels, of Virginia, Nev., sent slides of Meridion circulare, found in that vicinity at an altitude of 7,000 feet. Only two other authentic habitates are known in the United States for this diatom.

Mr. William Lighton, of Ottumwa, Iowa, sent an interesting description, with figures, of his new "eye-piece diaphragm," which gives the effect of a spot lens by reducing the proximal aperture of the eye-piece to a hole 1-20 inch diameter, so placed as to admit rays only on the side of the emergent cone of light.

After deciding to continue to the next meeting the topic, "Lower Forms of Marine Life," the society adjourned.

State Microscopical Society of Illinois.—A special meeting of this society was held on Thursday evening, Aug. 22, 1878, at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago.

The meeting was quite impromptu, the only notice being a few lines in the papers on the same morning. The attendance, however, was large, and great interest was manifested by the audience in listening to the remarks of Dr. W. H. Atkinson, of New York, who entertained them with accounts of some recent microscopic discoveries made in the laboratory of Carl Heitsmann, of New York.

At the close of Dr. Atkinson's remarks, Dr. W. S. Dennis (Vice-President of the American Society of Microscopists) of the San Francisco Microscopical Society, made some happy remarks, which led to a discussion of "what is a duplex lens." Mr. Bulloch, by means of diagrams on the black-board, gave the formula of one.

Besides the gentlemen mentioned, Dr. D. C. Hawxhurst, of Battle Creek, Mich., was also present. In fact, the meeting was called in order that our local microscopists might have the pleasure of meeting these gentlemen, who were just from the Indianapolis Congress, and was suggested by those who took part in a very enjoyable *seance* held the previous evening in Dr. Atkinson's room, at the Palmer House.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 8. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of manzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Magic lantern, nine slides (two mechanical) in complete order, in exchange for good compound microscope. T. R. Barwood, Flatbush, L. I.

Publisher's Department.

A Remarkable Photograph.—Through the kindness of T. H. McAllister, the well-known optician of this city, we are in possession of a microphotograph, which, so far as we know, has not hitherto been equalled. Our readers are no doubt familiar with those photographs in which the Lord's Prayer, the Ten Commandments, the Declaration of Independence, etc., are photographed on glass on a scale so small that they can be read only by a powerful magnifying glass. In general a power of 20 to 50 diameters brings out the letters clearly, but when a much higher power is applied, the letters appear ragged and granular. In the slide before us, however, the Lord's Prayer is photographed on the ten-thousandth part of a square inch, and so fine is the work that it will bear inspection with a good 1-6th objective and B eye-piece.

To give our readers a better idea of the character of this work, the following facts will be useful. The Lord's Prayer contains 227 letters and the whole Bible contains 3,566,480 letters; consequently the Bible, if written of the same sized letters, would fill a space 15,711 times that required for the Lord's Prayer. Therefore, if the Lord's Prayer can be photographed on the ten-thousandth part of a square inch, the whole Bible could be photographed on little more than an inch and a half. We have just measured a new postal card, and find that it is 5.13 inches by 3 inches, thus containing 15.39 square inches. Therefore, if proportionately reduced, the whole Bible could be photographed nearly ten times on an ordinary postal card.

We are aware that writing much finer than this has been executed on glass with a diamond, but we believe that this is the finest sample of photography ever produced. It is proper to add that it is the work of Mr. Langenheim, whose slides of the Declaration of Independence have long been well known to microscopists. The new slides will no doubt find a place in the cabinets of many of our microscopists as remarkable curiosities.

The American Institute.—The exhibitions of this association have for more than half a century constituted the "Permanent Exhibition" of New York, and whether considered as a means of education, through the display of valuable products and processes, or as a most effectual means of bringing to the notice of the public the novelties which are brought forward every year, the Institute Fairs have always stood foremost amongst the exhibitions of this country—always, of course, excepting the Centennial. The Exhibition opens this year on the 11th of September, and those who desire to avail themselves of its advantages should make haste to address the Secretary, whose office is in the Cooper Union building.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, SEPTEMBER, 1878. No. 9.

Proceedings of the National Microscopical Congress, held at Indianapolis, Aug. 14, 15, 16 and 17, 1878.

WE are indebted to the Secretary of the Congress, Mr. H. F. Atwood, of Chicago, for the following very complete report of this important meeting:

The National Microscopical Congress, which was held in Indianapols Aug. 14, 15, 16 and 17, accomplished a great deal more than even its projectors dared to anticipate, and too much credit cannot be bestowed on the two gentlemen, Drs. Jamison and Butterfield, of that city, to whose efforts much is due for the success of the undertaking.

A babe was born at this meeting, and christened "The American Society of Micropists." For it we predict a great future, for even from its first entrance into this world, it began to show its strength and spirit of independence, and in opposition to the views of some of its nurses, it stubbornly refused to take a subordinate position, but, Young American like, persisted in retaining its individuality; with a rare perspicuity remarkable for one of its tender age, it saw that in future years, when grown to be an acknowledged power, the credit of its greatness would be still further enhanced by the thought that it had at no time been supported by a similar though older organization.

Beyond the formation of this new society, other and equally important results were attained; views were interchanged, results were compared, new and valuable acquaintances were formed, and older ones were cemented.

Delegates began to arrive on the 13th, and continued until the last day, probably the greatest number present at one time being about sixty. Among the societies represented we would mention:

San Francisco Microscopical Society, of California.

Jamestown Microscopical Society, of New York.

Buffalo Microscopical Club, of New York.

New York Microscopical Society, of New York City.

Louisville Microscopical Society, of Kentucky.

Dunkirk Microscopical Society, of New York.

Indiana State Microscopical Society, of Indiana.

State Microscopical Society, of Illinois.

Micro Section Troy (N. Y.) Scientific Association.

Micro Section American Association for the Advancement of Science.

Micro Section Tyndall Association, of Columbus, Ohio.

Biological Section Indianapolis (Ind.) Lyceum of Natural History.

American Postal Micro-Cabinet Club.

Buffalo Society of Natural Sciences, of New York.

Chicago Academy of Sciences, of Illinois.

Philadelphia Academy of Natural Sciences, of Pennsylvania.

FIRST DAY.

On assembling the first day, Rev. A. B. Hervey, of Troy, N. Y., was elected temporary Chairman, and Mr. H. F. Atwood, of Chicago, temporary Secretary. Rev. J. B. Cleaver, of Indianapolis, opened the deliberations with a short and impressive prayer. This was followed by an address of welcome by Mayor Caven, in which he paid a glowing tribute to the microscope, and the grand results to science from its use.

On behalf of the local scientists, the Congress was then welcomed to Indianapolis by Dr. O. Evarts, Superintendent of the Hospital for the Insane. He extended a most cordial welcome, and in eloquent but well-chosen words expressed his gratification that so young a city as Indianapolis should be selected for such a gathering.

As showing what an Indianapolis physician can do in the way of rhetoric when his heart is overflowing with gladness, we quote a few lines from his address:

> And let me now predict that a time will come, and is not distant, when Christianity itself, in which are aggregated all of the imperishable elements of religious truth and good, will recognize and confess its obligations to science for having aided and affected a withdrawal of its living elements from the dead and burdensome concretions of Egyptian, Chaldean, Hebrew, Greek, Roman and Germanic paganisms, with which its imperial and pontifical propagandists almost inextricably environed them. And science in return will preceive and accept the incontrovertible truths of Christianity as essential to the fullness of its own discovered truths. We are approaching such an epoch. Compare the religion of to-day with the religion of any former century. Does it not occupy a similar relation to its past self that modern science occupies to the intellectual speculations of ancient and mediæval philosophers? Is not the Christianity of to-day, as manifested in the higher and more intelligible expressions, to the Christianity of past ages as the astronomy of Galileo and Newton, Herschel and Laplace is to the astrology of Egypt and Chaldea? as the chemistry of Lavoiser and Davy is to the alchemy of Geber and Paracelsus? And, except by such persons as may still regard parson Jasper, of Virginia, as a better exponent of religious truth than Professor Cook, of Boston, it must be conceded by all that this *pari passu* progress of science and morals is significant of something more than a mere coincidence.

The temporary chairman, Mr. Hervey, responded to these words of welcome. He said the delegates were proud of being received in the name of the intelligence and morality of the community, and they recognize the force of the welcome extended. Indianapolis has a reputation for science and hospitality rather more than local. The members of the American Association for the Advancement of Science, which met here several years ago, have spread its fame in these respects to every part of the land, and not one of the delegates come up here ignorant of the qualities possessed by its people. We are glad to meet in this thriving city, in this magnificent building, in this beautiful room, resplendent in the wealth of its decoration, and to mingle awhile with you in social life, forming acquaintances and associations that shall lose nothing in their sweetness throughout our lives. Mr. Hervey then addressed a few words to the delegates in behalf of the right of the science of microscopy to exist. He said the delegates hoped during their stay in Indianapolis to bring to the notice of those with whom they came in contact, new beauties in nature through the use of the microscope, and that from this meeting a new interest in the study of the science should arise in the city, to the growth and prosperity of the local microscopical society, under whose auspices the Congress is held. In conclusion Mr. Hervey said the gathering was in the interest of religion as well as science, believing that the true interests of one could not be affected without influencing those of the other.

At the suggestion of the chairman a motion was made providing for a committee of five to nominate officers for the permanent organization.

The committee, after a short recess, reported the following, who were elected:

President—Dr. R. H. Ward, Troy, N. Y.

Vice-Presidents—Prof. J. Edwards Smith, Cleveland, O.; Dr. W. Webster Butterfield, Indianapolis, Ind.

Secretary—H. F. Atwood, Chicago, Ill.

Treasurer—Dr. J. B. Marvin, Louisville, Ky.

After suitably acknowledging the honor conferred in selecting him President, Dr. Ward took the chair. The Secretary then read two papers. The first was by Prof. William A. Rogers, of Harvard University, on the "Limits of Accuracy in Measurement with the Microscope." The second, which we here republish, was by C. C. Merriman, of Rochester, N. Y.,

ON SOME NEW FORMS OF MOUNTING.

I have the pleasure of offering, as my contribution to the Microscopical Congress, a brief description of some recent methods which I have used in the preparation of slides. The cement which is essential to these processes, and which I regard as the most important working material of the microscopist, is shellac varnish, prepared in the following simple manner: The white purified gum of shellac is dissolved in alcohol, and filtered through cotton one or more times until it is quite clear and transparent. As the filtering is a somewhat difficult operation, it will probably be best for most persons wanting it to let the druggist make this preparation for them. With this cement I build up a cell as deep, and perhaps as quickly, as one can be made with a curtain ring, painted up as it usually is. As much as one or two drops of the cement can be put on a slide with a brush, using the turn-table, and then slowly worked up into a narrow ring with the point of a small knife-blade held on the turning slide. When this has dried a day or two, another layer can be put on and worked up in the same way. Three or four such layers will be sufficient for almost any cell, and it can then be dried in the heating oven and laid aside for further use. By carrying along a dozen or two slides at a time, one will find great economy both of time and labor. These rings, being transparent, are admirably adapted for opaque mountings that may be used with the Lieberkuhn.

If common curtain rings are cemented to slides with the shellac cement, colored with aniline blue, (the joined edges of the brass film of which they are made being on the glass) and then subjected to a slowly increasing heat until the cement begins to burn, a very beautiful appearance is given to the under side of the ring, a circle of minute golden links, as seen in the specimens which I offer for your inspection. These rings can then be painted on the turn-table according to one's fancy, and used as cells for any kind of mounting.

I use this cement colored with the various aniline dyes, which are soluble in alcohol, for painting and finishing slides. These colors are far superior for all purposes of ornamentation, to any other materials or devices of painting. They dry quickly, and adhere to glass with greater tenacity than any other cements that I have ever used.

For a cell that will perfectly withstand the action of Canada balsam or turpentine, I make use of shellac cement colored with aniline blue, in the following manner: After a cell of the required depth has been made on the slide, and pretty thoroughly dried in the usual way, it is heated on the heating table, lightly at first, in order to avoid bubbles, then gradually increasing the heat until the cement commences to smoke and the color to burn out. By heating one side of the ring a very little more than the other, as may be done over an alcohol lamp, a part may be left blue, while the rest is yellow or reddish, which has a very pretty effect under Canada balsam. These cells are hard as bone, and can scarcely be cut from the glass. Balsam has no effect on them whatever. Mountings in them may be finished off with liquid balsam made true and circular with the point of a knife on the turn-table. In a few days, or in a shorter time, by using the oven, they will be ready to clean and lay away. The cells which I have described are the only cement cells that can be used with Canada balsam. They are particularly adapted to vegetable stainings, algæ, and other preparations either too thick or too tender to be mounted in balsam without something to sustain the thin glass covers.

In opaque mountings, where cements of any kind are used, either for backgrounds or to hold the objects in place, I have found it highly advantageous to leave on, or in, the lower part of the ring, a minute aperture opening into the cell, not necessarily larger than a fine cambric needle would make. With this provision both the cell and the cements go on drying, and there is no sinking in or moving about of the objects in the mediums which hold them. But if the cell be hermetically closed one may almost certainly expect that the beautiful shell or other object will sooner or later be overwhelmed in a black sea. I have lost in this way scores of foraminifera and corallines on which I had expended a deal of labor. If curtain rings are used for the cell, a little notch can be filed in the under side of it, and this be left open on the lower side of the slide when finished.

If the opaque mountings are for dry objects, I make in the centre of the ring a disc of Brunswick black, or white zinc, according as the object to be shown is white or dark. It may be 5-16 of an inch in diameter for the Lieberkuhn of the 1¼ inch objective, but not over a quarter of an inch for that of the two-thirds objective. After the cement is dry and quite hard, a slight coat of balsam is spread over it, and the objects placed in this and arranged if necessary under the microscope. The slide is then set aside to dry, and may be covered safely the next day.

If the objects to be mounted will bear immersion in balsam, as shells, plant seeds, minerals, etc., I pursue the following plan: The thin glass covers are cemented to some old slips, which are kept for that purpose, by two or three touches of balsam applied at the edge of the cover. Care is taken in this, and in all cases, to accurately centre all work on the slides by means of the self-centering turn-table. Then, on a light coating of balsam in the centre of the cover, the objects, whatever they may be, are placed and arranged. When quite dry, and the objects are thus securely fastened, they may be completely covered by balsam, and put into the drying oven until thoroughly hardened. Then, over the balsam, Brunswick black, if the objects are white, or white zinc cement, if they are dark or high colored, may be spread by thin layers at first, each being dried in the open air for a day before the next is applied, until there is an opaque covering to the objects. The thin glass cover is now to be thoroughly cleaned around the objects and then removed from the slips by a slight heating, just sufficient to loosen it. It can then be turned over and mounted on the cell designed for it.

The best preparation for fastening the cover to the cell is gelatine, dissolved in water, with enough alcohol added to liquefy it from the jelly state. I place the thin glass on the cell, and then apply the gelatine solution with a brush around the edges, leaving the little opening on the lower side. Just enough of the water cement seems to run in under the glass, and to dry just where it is placed. Afterwards the cell may be finished with liquid balsam, carefully avoiding the little aperture, and the outer edge gathered up into a neat, trim little circle, with the point of a knife, on the turn-table.

The last and most important recommendation which I have to make, is the strict observance of every rule and precaution tending to neatness and cleanliness. There is a world of beauty and delight in the revelations of the microscope; and there is a peculiar fitness that all the surroundings should be likewise lovely. Whenever I receive a mounted object disfigured with dirt or fibres, with ragged or unfinished settings, I write another name in the already very considerable list of "Exchangers to be avoided."

At the conclusión of the reading of this paper, the Congress took a recess until 3 o'clock.

The paper by Prof. Rogers, which we hope sometime to publish in full concluded as follows:

I think we may safely draw the following conclusions from this investigation:

1. Two equally skillful observers can measure the same space within about one-300,000th of an inch if the space does not exceed one-500th of an inch. For a space of one-100th of an inch, the deviation will probably amount to one-80,000th of an inch, in case the measurements are made with an eye-piece or a filar micrometer.

2 The average deviation for accumulated errors, under similar conditions, is not far from one-50,000th of an inch for eleven intervals. For a large number of intervals the deviation will be somewhat larger, but it will not be proportional to the number of intervals.

3. A single observer can obtain an agreement with a normal equation representing all the observed values as far as a solution by least squares can represent them, within somewhat smaller limits than those obtained by comparing the results obtained by two different observers.

The afternoon of the first day was devoted to a sort of conversazione and examination by the delegates of the many beautiful stands and accessories exhibited by such well known dealers as Walmsley, Jas. W. Queen & Co., the Bausch and Lomb Optical Company, and Bulloch, of Chicago—the latter exhibiting his new large stand which he will call "The Congress." It would of course be invidious to praise one stand more than another, but it is a matter of record that the stand referred to, was, after a searching examination, highly praised by men to whom we are accustomed to look as authorities in such matters.

The first evening, as in fact all the evenings, was grand; private "seances" were held in different rooms throughout the hotel, and heartily enjoyed by the fortunate participants.

In Dr. Geo. E. Blackham's room the writer saw for the first time the resolution of the *Amphipleura pellucida* in balsam under a Tolles' duplex sixth, the lines standing out as tangible as those of a *pinnularia* under an ordinary half inch.

A visit to the room of Prof. J. Edwards Smith found that gentleman entertaining a select circle of friends with a Spencer four-system quarter, that with perfect ease would run through the balsam "probe platte." High angles were in the ascendancy and more than one convert to that faith can date his regeneration from that evening.

SECOND DAY.

On the second day of the Congress, after the minutes of the previous meeting had been read and approved, on motion of Dr. Jamison, C. M. Vorce, J. F. Stedham, Romyn Hitchcock, W. W. Butterfield, and H. F. Atwood, were appointed as a committee to report a plan for permanent organization. An amendment by C. M. Vorce, adding one delegate from each society to this committee, was accepted.

There being no further miscellaneous business, the regular programme was taken up.

W. H. Bulloch read a paper on the "Formula of Objectives," illustrating the difference between Wenham and Tolles by drawings, presenting the subject in a clear manner, and was listened to with marked attention.

Dr. Geo. E. Blackham read a paper on "Angular Aperture," the substance of which is as follows:

The doctor began by stating that the function of an object glass for the microscope was to gather up and bring to a focus rays of light emanating from an object which would otherwise diverge too widely to be received by the eye. At the focus to which the rays are thus brought is formed a brilliantly illuminated image of the object, which is again magnified by the eyepiece. Rays diverge in every direction from the surface of the object, but the unaided eye can only utilize a pencil of about ten degrees. It is the function of the object glass to gather in and bring to a focus many of these rays which would otherwise be lost. The angular difference between the paths of the outside rays of the widest pencil of light which an object glass can thus gather up and bring to a focus with the formation of a well defined image is the angular aperture of that object glass. He then briefly reviewed the history of the construction and improvement of the microscope, showing that as the instrument had been improved the angular apertures of object glasses had been increased, till an air angle of 180 degrees had been reached. He next gave a critical review of the various methods proposed by Mr. Wenham, of London, England, for the angle of aperture, showing their inconsistencies. He objected to using a microscope as a telescope, and viewing distant objects with it while measuring angles, and insisted that the only proper way was to have the instrument in actual use with an object in the centre of the field, and all things so arranged as to secure the best possible definition. He spoke of the fact that many lenses will admit rays of light more oblique than they can utilize for the formation of a good image, and insisted that such rays should not be counted in measuring the angle. He stated that the larger the pencil of rays which an objective could actually utilize in the formation of a well defined image—or, in other words, the wider its angular aperture, the better the lens, and, in proof, cited the fact that a one-sixth immersion object glass, made for him by Mr. Tolles, of Boston, Mass., would show clearly Nobert's nineteenth band, ruled on glass, 112,594 lines to the inch, and the lines on *Amphipleura pellucida* in balsam, No. 20 of the Moller probe platte, 95,000 lines to the inch. In the course of his paper he demonstrated his own method of measuring apertures, and exhibited a beautiful microscope of novel construction made for him by Mr. Tolles, with certain special appliances for this kind of work.

The next was the following paper by C. M. Vorce on

MECHANICAL FINGERS:

This accessory to the microscope is by many microscopists regarded more as a toy than a serviceable and useful appurtenance. Yet to almost all except those who confine their labors to tissues, fluids, and objects easily handled, this accessory may be made of great use.

The mechanical finger is in fact a stage forceps adapted to objects too small and fragile for the ordinary forceps. And the diatomist who has with his mechanical finger picked up a valve or frustule, turned it over, set it on end, on its side, or rolled it backward and forward under the objective, has learned more of that valve or frustule than many others are likely to do who have only examined the same object in the position in which it has chanced to fall, and this one is likely to value the mechanical finger as one of his most useful tools.

Nor is it to diatoms alone that the fingers we speak of may be applied. Minute scales, hairs, crystals, shells, and many other things may be more fully examined with it than by any other means. And if it even were not useful, its capabilities in the preparation of things merely of beauty is sufficient to endear it to very many and render it worthy a place in every accessory box.

And when this apparatus can be so easily and cheaply made, and made by every worker for himself, it ought at least to be favored with a test by every owner of a microscope.

The mechanical finger, in mode of operation, may be roughly divided into three groups.

First, and most limited in use, where it is used attached to the microscope body, moving with it, and where there is no substage nor mechanical or movable stage.

Second, Where it is attached to the body and there is a sub-stage or movable stage.

Third, Where it is attached to the stage and there is a sub-stage or movable stage, or both.

There is a fourth class where it is attached to the sub-stage, but it is seldom so used.

However it is attached, the greater the number of separate movements possessed by the stage and substage the greater is its efficiency.

Considering the groups in their order, the first group is limited by the lack of a vertical motion independent of the finger; the power to lift or lower the object in examination is of great value, and doubly so in mounting.

Between the second and third groups there is little to choose in use for examination, but, in mounting, the second group lack the ready and safe means of examining the field with the finger point out of sight and of viewing the mount in the same manner.

In all cases, the mechanical stage is superior to the hand-sliding stage in the smoothness and precision of its movements, and less liability to accident by a sudden slip or movement, and in mounting in arranged lines or patterns the precision with which, by the mechanical stage, the object suspended on the finger may be brought exactly over its destined place and securely lowered into it, like a stone on a derrick, is unequalled by the hand.

The construction of this useful accessory may be complex or simple, costly or absurdly cheap, but of whatever kind it be, in skilled and loving hands its performance will give a good return of gratification.

The simplest form of construction I have met with in fingers of the first group, consists of a brass plate thick enough to be moderately firm, perforated at one end with a hole which slips over the thread of the objective, and is screwed up against the body; the other end is formed into a tube which is slightly turned up and through which slides a wire, carrying at its lower end the hair or bristle; an upright wire is fastened to about the middle of the first wire, and passes up through the first named plate; is threaded at top and raised by a thumb nut; the spring of the lever will lower it when the nut is slacked. This affair, which did not cost its owner a cent, has done some very nice work, but at a disproportionate expenditure of time.

Dr. W. B. Rezner, of Cleveland, Ohio, devised a more elaborate finger to be attached to the objective by a clamp. This is moderately costly, but can do beautiful work. It is on exhibition here.

There are many other forms designed to be attached to the body or objective, but none more efficient than Dr. Rezner's, in my opinion.

Of course any fingers of the first group can be used under the conditions of the second group with greatly increased success.

Of the third group, the simplest form I know of consists of a tube extending up from the sub-stage through the stage well, and bearing at its top a plate to hold the slide. Through a peg in the stage forceps-carrier is passed a wire, with its inner end carrying the bristle. This is all there is of it, and any school boy can make one of tin and wood, with nothing better.

With a good stage, preferably mechanical, this finger can do good work, proportioned to the skill of the worker. Samples of work with this apparatus are on exhibition, whence its capacity can be judged. More elaborate forms of this class of fingers are made and sold at various prices, and work done with them is also exhibited, being the handiwork of Mr. Christian Febiger, of Wilmington, Delaware, who has brought the use of the mechanical finger to a state of true art. The specimen exhibited is very far from showing his best skill.

The usefulness of the finger is very much enlarged when it is furnished with a variety of points suited for different kinds of objects. Thus, for work in handling or mounting diatoms, a fine, smooth pointed hair or very fine bristle, such as a mouse's whisker, is needed. For scales of insects and such objects, a fine sable hair will answer best; for spicula, crystals, etc., a coarser hair—a cat's whisker tip, or a finely shaved point of a whalebone or quill, is preferable; and for foraminifera and such objects a still stronger bristle or a split point of quill or whalebone may be used.

It is most convenient to have the several hairs, bristles, etc., each mounted in a similar wire, any one of which may be put in place and used, as the class of work to be done may require.

I venture the prediction that whoever adds a mechanical finger to his array of accessories, and begins the use of it, will not thereafter willingly be without one.

It is scarcely necessary to say anything regarding the manner of using the mechanical finger, since the mode of operation is almost necessarily obvious from its construction; but if some workers who have not attempted the use of this accessory shall be induced to give a trial, as I hope may be the case, a few hints at the outset may be of use to them.

That point which seems to me to be of the first importance to the successful use of any form of mechanical finger, is the angle which the hair or bristle in use makes with the plane on which the object rests. If the hair stands at a considerable angle with this plane, it is very difficult to roll an object under the hair, owing to the liability of the hair to slip from it, which often results in throwing the object out of the field, and sometimes in its disappearance entirely. On the other hand, if the hair is set at too small an angle, it has too little bearing force, and is liable to gather up not only the object desired, but several others that may lie in close proximity to it. Considerable experiment has led me to believe that about 20° is the best angle for general purposes, although it may with advantage be varied for different kinds of work. Hence, a mechanical finger which provides a means for changing the angle of the point or hair is preferable to one without it.

The worker will sometimes be annoyed by an electrical condition of the hair, causing objects to adhere to it and stand out from it as if electrified; removing the wire and wiping the hair with the fingers will generally cure this trouble.

The means of revolving the wire that carries the hair should always be provided, so that objects picked up on the hair may be thus turned upside down, exposing the under surface. All movements should be very smooth and free from jar, and the same is true of the movements of the stage, since an object may be utterly lost by a single blow or jar communicated to the bristle wire which forms a spring sufficient to completely devastate the field under view, and if this happens to a nearly completed mounting of choice objects, profanity is likely to result in some cases.

In mounting objects selected by the mechanical finger, no departure from ordinary processes is required, unless they are to be mounted in some particular design or position. In this case the objects must, of course, be fastened in their places, and gelatine is the medium generally accepted for this purpose.

A cover glass cleaned and fastened to a slip by a little touch of wax at its edge, or to a special corner with a light spring, is preferable on which to mount, although the mounting may be done upon the slide.

It is common to place a considerable number of the objects as selected upon the cover or slide before arranging them, and then to arrange them in their desired position, and finally fasten them, which is most commonly done by simply breathing on the film. An instant exposure of the arranged slide to steam will more effectually fasten the object than the breath, but is liable to imbed them too deeply in the gelatine film.

The occasional disarrangement of a considerable number of objects already arranged, while endeavoring to place another in position, has led me to adopt the plan of fastening each object in place as it is put there, by breathing on the slide before placing on another object. This will prevent the labor of perhaps half an hour being destroyed by an untoward slip or jar just when success seems to be at hand.

I would also recommend that in all cases a cell be used in mounting arranged objects, to prevent their being crushed afterwards, or forced out of position by the drying of the medium in which they are mounted.

A great many additional points will suggest themselves to the worker as he progresses, and as his success improves, his ambition is likely to keep pace with it.

It is self-apparent that whatever be the form of apparatus used, the skill of the worker will be the measure of success, although good tools facilitate good work, and surely no one need lack the opportunity for efficient work when the means thereof are so easily procured.

The Convention met promptly at 2 o'clock P. M., and proceeded with the programme, which announced a paper by Romyn Hitchcock, which was a lengthy review on "Angular Aperture Defined." He concluded by summarizing as follows:

First, we should settle upon certain requirements which the definition must fulfil, and these may be given as follows:

1. It must be concise, and must admit of no misunderstanding.

2. It must be one which can be practically applied in measuring aperture without dispute as to the accuracy of the results obtained.

3. It must be applicable to all objectives, dry or immersion.

4. It must be an angle, measured under such conditions as the objective will work in practice: that is to say, a dry objective must be measured dry—an immersion must be measured in its fluid.

It is claimed upon the other side that all apertures should be given in air; that is, that in order to make the angular apertures comparable with each other, the air angle should be stated, whether the objective is dry or immersion.

This, it seems to me, is merely an arbitrary demand, made by a few of the present day, but without the least pretence for a scientific basis. What is the air angle of a glass that does not work in air? Is it not purely hypothetical? What possible knowledge can it convey to us? I will grant that when the balsam angle, for example, is increased beyond a certain point, the corresponding air angle, if it were possible to have such, which I emphatically deny, would exceed 180°, or, in fact, would not enter the lens at all.

It must follow that the expression 180°, is a vagary, and we must discard it from scientific discussion. I base my argument on the undeniable fact that the aperture of an immersion objective is the angle which the light actually forms within the medium of immersion. This can not be fairly denied. I claim, too, that any hypothetical angle without the fluid intermedium is one for which the objective is not adapted, an angle which it can not possibly utilize, and that no angle can express anything as to the value of an objective, unless it is an angle which can be put into actual use.

Next in order came the paper of Prof. R. H. Ward, on "The Microscopical Study of the Ashes of Leaves." He said:

The unexpected interest excited by a specimen of the ashes of a fragment of rice leaf, which he contributed to the Postal Club, led to the presentation of a series of the objects, and an explanation of the method of preparing them. Little attention seems to have been given to the subject lately, and it has been scarcely noticed that other leaves than the siliceous ones of the grasses can be so studied. By carefully burning a portion of dried leaf on platinum foil or thin mica, all the combustible part can be driven off and the ash remain unbroken, and exhibit very perfectly many of the microscopic features of the structure. A large series of instructive objects can thus be prepared with little time or labor. Old leaves in autumn are most suitable, and those of trees are generally preferable to those of short lived plants.

The Rev. A. B. Hervey next claimed the attention of the meeting in a discussion on the "Classification of Algæ."

This was followed by a general discussion, and a very heated one too, especially between Messrs. Hitchcock and Smith, Mr. Hitchcock arguing that this convention should establish a proper definition for "angular aperture," and to this end submitting the following preamble and resolutions:

Whereas, The subject of the angular

aperture of objectives has been discussed for many years without great benefit to science, or showing even now a fair prospect of a satisfactory settlement;

Whereas, We believe that much of this discussion has sprung from the undefined meaning of the term;

Whereas, We, representing in this National Microscopical Congress the various societies and classes of microscopists in the United States, believe that by recommending and adopting a definite meaning for the term, can advance the interests of true science; and

Whereas, In the present state of our knowledge of objectives, we see no indications that the capacity of an objective to resolve lined tests depends upon its angular aperture, as distinguished from other optical qualities apart from workmanship; therefore,

Resolved, That we adopt the following as a definition of angular aperture as applied to the objectives used with the microscope. The angular aperture of a microscopic objective is the angle at the apex of a triangle, having a base equal to the available diameter of the front lens, and a height equal to the actual focal length (working distance), measured in air for a dry lens, and in the fluid employed for an immersion, the collar being adjusted for the most perfect definition in each case.

Resolved, That we request all makers to mark their objectives in future to correspond with the definition above adopted.

Resolved, That this preamble and resolution be distributed in circular form among the various societies and makers of objectives, with the request that they give it their formal approval, and communicate whatever action they may take to the body or the committee, as the Congress may appoint.

Resolved, That we recognize that the interposition of cover glass, balsam, or any other medium of a different refractive power from the one for which the aperture is given, has more or less effect upon the aperture and image, and we recommend this as a subject for investigation.

The introduction of these resolutions called forth quite a spirited debate, and the subject was argued pro and con, until finally the resolutions were withdrawn by Mr. Hitchcock.

An invitation by the Union Belt road managers to ride around the "belt" on Friday afternoon was accepted; also the invitation tendered by the citizens, to a *soiree* on the same evening, was accepted, and the meeting adjourned to 8 P. M., to meet at the parlors of the Grand Hotel, where a conversazione was held in the evening.

THIRD DAY.

The third day's session of the Congress was largely attended, and the proceedings were attended with great interest. A paper by Dr. W. T. Belfield, of Chicago, which had been laid over from the Wednesday's session, was first introduced.

THE MIGRATION OF LEUCOCYTES.

In March last I had occasion to superintend the post mortem examination of a case of pneumonia, in which death had occurred on the tenth day of the disease. There was found consolidation of the entire left lung, gray hepatization in the lower lobe, red in the upper. Nothing peculiar was noticed in the other organs except general engorgement, especially marked in the kidneys. There had been during our observation of the patient not a solitary symptom of renal disease, except the presence of albumen (about ten per cent) in the urine, a presence known to be common in pneumonia, and attributed to mechanical congestion. For at least three features of pneumonia tend to the producticn of pyrethamical congestion, namely: The decrease in breathing surface, the increase in the demand for oxygen made by the excessive tissue change, and the feebleness of the heart's contractions. Hence the albuminuria and the post mortem engorgement of the kidneys were regarded as legitimate results of the disease. A happy curiosity, however, led me to make a microscopic section of the kidney. I found the tubules rather smaller than usual, the intertubular spaces and capsules of the Malpighian tufts much thickened by the presence within them of numerous small, round, finely granular cells of 1-2400 to 1-3000 inch in diameter. These cells had every appearance of white blood corpuscles, and were so pronounced by Dr. Danforth and others. By way of explanation it was presumed that the retardation of the blood current due to the causes previously mentioned had afforded the colorless corpuscles an opportunity to exhibit their amœboid movements, and that the opportunity had been improved. That this was not an inflammatory process was proved by the absence from the clinical history of all the recognized symptoms of renal inflammation, and by the absence from the urine of the exudation cylinders or tube-casts. Nor were the microscopic appearances of the organ those of inflammation.

Within six weeks I had an opportunity of examining the kidneys of two other patients, dead from pneumonia, without previous history of renal disease. In each case the urine contained a small quantity of albumen, but no casts, and in each case colorless corpuscles were found in abundance in the intertubular tissue, and in the Malpighian capsules. At a meeting of the West Chicago Medical Society, held June 10, I exhibited a section from one of these kidneys, and another from a normal kidney, demonstrating to the satisfaction of those present the existence within the connective tissue of the former organ of the small round cells above described. At that time I had sought unsuccessfully for literature, or a reference to literature on this subject. However, deeming the fact, if it were a fact, of the migration of leucocytes in passive hyperæmia a very important one, pathologically, I determined to investigate the case, and for that purpose instituted the proceedings about to be narrated.

On June 19, I curarized a frog, cut down in the femoral vein (which can readily be done without injuring the artery, as in this animal the vein and artery lie on opposite sides of the femur) made compression by means of a rubber band and a plug of cork, and stretched the web of the corresponding foot on the stage of the microscope. I employed a Hartnack No. 4 objective, and a Gundlach C periscopic eyepiece. By watching the blood movements, I easily regulated the pressure so as to retard, more or less completely, the onward movement, avoiding complete stagnation. After considerable compression had been exerted, as was shown by accumulation of blood-corpuscles, distention of the veins and retardation of the current, the field was carefully watched for nine hours. During that time no leucocytes were actually observed to leave the vessels, yet several were seen just external to the walls, having apparently escaped unnoticed during the shifting of the stage. For the next ten hours the field was not observed with sufficient care and frequency to warrant any assertion of migration. At the end of this period, however, that is, nineteen hours after compression was made, an almost continuous observation of the field was begun. From the nineteenth to the thirty-sixth hour leucocytes were observed to leave the vessel in considerable numbers, the shortest time of exit observed being twenty minutes—the average, one to two hours. The method of locomotion did not, of course, differ from that exhibited in inflammation, though at no time did I observe the excessive change of form and protrusion of long processes figured in the books. There was frequently a flattening of the leucocytes against the wall; then the appearance of a bud external to the wall; then the gradual enlargement of this bud, and shrinkage of the intra-vascular portion—the part piercing the wall being apparently a tunnel through which the rest of the body passed. Often the locomotion was continued after the leucocytes had become wholly extra-vascular, so that it traveled several times its own diameter from the place of exit. It was noticed, too, that other corpuscles were prone to pass out at the particular point of previous immigration, so that sometimes several would be crowded together along the vascular wall, and an hour later would be in close proximity external to the vessel opposite the same point. This phenomenon occurred usually not in the minutest capillaries, but rather in the large capillaries and small veins, ranging from 1-1500 to 1-1600 of an inch in diameter. Nor were the passages always made where the current was slowest, nor where the vessel gave evidence of greatest engorgement by the crowding of the corpuscles, as emigration from a rapid current, but sparsely supplied with corpuscles, was not infrequent.

Before I had watched the process a great while, I became aware that the colorless corpuscles were not the only bodies exhibiting amœboid movements. I observed that certain red ones, without nuclei, of circular shape and small size (1-2500 inch in diameter), performed the same movements, with as great celerity as did the white. (The listener is reminded that in the frog the perfect red corpuscle is of elliptical shape, is 1-1200 inch in its longer diameter, and has a distinct nucleus; while the white globule is, when at rest, of circular shape, its diameter only about 1-2500 inch.) There could be no possibility of confounding these small red ones with the white, for although in size, shape and movements they were identical, the red color of some was unmistakable. So extensive was the locomotion of the red ones, that at the thirty-sixth hour of the experiment there were numerous red patches in the field, which looked almost like hemorrhages. That they were not hemorrhages I knew; first, because there were no large oval corpuscles, the red globules proper, but only the small circular ones; second, because they were fixed in the tissue, not floating to and fro in the blood serum; third, because I had seen many of them migrate.

These phenomena were witnessed not by myself alone. Dr. Bridge (Lecturer on the Practice of Medicine) observed the emigration of several corpuscles; Dr. Danforth, professor of pathology and pathogenesis, while enabled to watch the process for a considerable time, was convinced that emigration actually occurred; Miss Meigler observed numerous red as well as white cells leave the vessels.

Having established the fact of the locomotion, therefore, it remains to prove the dependence of that locomotion upon mechanical congestion rather than upon active hyperæmia. That congestion existed was shown not only by the retardation of the blood current and dilation of the vessels, but also by œdema of the web, which became evident within twenty-four hours. That the congestion was not "active" was established by two facts; first, the absence of all the phenomena of inflammation other than the amœboid movement, i. e., the primary acceleration of the blood current, the subsequent retardation with irregular contractions of the vascular walls; second, that the discontinuance of the pressure on the vein was at once followed by complete restoration of the circulation in the web, whose irregularities, therefore, were dependent wholly on a mechanical impediment, and not upon any "nutritive irritation" nor vascular spasm.

This experiment has been repeated twice since the above date. In both instances emigration occurred; in one it began within three hours after compression was made. In this case the pressure exerted exceeded somewhat that made in the first instance.

Now, the value of these facts depends upon one's ideas of pathogenesis. If he believes, with Billroth, that connective tissue is developed solely from migrated blood corpuscles, he has a key at once to the connective tissue hyperplasia of the skin and venuous walls which accompanies a varicose condition of the veins. For the mechanical congestion necessarily present must result in the emigration of blood-corpuscles into the surrounding tissues, and these are developed, says Billroth, first into spindle cells, and finally into complete connective tissue corpuscles, causing the familiar thickening of the skin and vascular walls. In support of this view is the fact that the increase in thickness in the walls of a varicose vein is due to hyperplasia, not of the muscular elements, but of the connective tissue bundles interposed among those elements, and of the outer coat of the vessel, which is composed wholly of connective tissue. So, too, the enlargement of the spleen, which usually follows portal obstruction, as in cirrhosis of the liver and the thickening of the superior hæmorrhoidal veins—'hæmorrhoids'—form the same and other conditions, are to be referred, in part at least, to the development of leucocytes which have wandered from the vessel during the mechanical congestion. Perhaps, too, the areolar hyperplasia so often found with displacements of the uterus, is due to the venous congestion which usually exists in that condition.

Even the conservatives, like Stricker and Rindfleisch, while insisting on proliferation of pre-existing cells as the more important source of connective tissue hyperplasia, admit the strong probability that a considerable part of it is due to the development of the wandering cells or colorless corpuscles first into spindle cells, then into fibrillated tissue. Certain it is that in the repair of wounds, at least, they play a prominent part in the formation of cicatricial tissue.

The fact of emigration without any evidence of that "nutritive irritation" of tissue which Virchow presumes in active hyperæmia would seem to favor Henry's view that the exit of corpuscles is a passive rather than an active movement due to their glutinosity, to increased blood pressure and diminished blood velocity—in short, a simple filtration of colloid substances.

Then, again, the behavior of the small red corpuscles is interesting as exhibiting their close relation with the white, and as furnishing another link in the chain of circumstantial evidence that the red corpuscles are transformed white ones. Such has for some time been the prevalent opinion, though never completly demonstrated. The fact that the red ones were but little, if any, larger than the white, that they were of circular shape, were devoid of nuclei, and possessed the power of amœboid motion, proves their close connection with the colorless cells; while the presence of hæmoglobin, as indicated by their color, testifies to their ability to perform at least one important function of the fully developed red ones, namely, the transportation of oxygen.

Upon further examination of the literature of this subject, I find in Wagner's Pathology (p. 188), Charlton Bastian cited as authority for the statement published in the British Medical Journal for 1868, that "red globules as well as white leave the vessels in venous stases, scorbutus, etc., by means of amœboid movements." Not having had access to the journal I do not know upon what observations he based his statements, nor whether he had made investigations similar to my own.

MICROSCOPIC MEASUREMENT.

This subject was ably discussed in two papers—one by Prof. Hitchcock, and the other by Mr. C. M. Vorce. The paper by Prof. Hitchcock was headed "A Standard Micrometer," and the most important passages in it were as follows:

The subject that I wish now to bring before this convention is of such importance that it seems hardly necessary to say anything to call your attention to it. The need of a definite and accurate standard for microscopic measurement has been recognized by some for many years. As an example of this Prof. Lyons, in 1857, proposed to the British Association for the Advancement of Science that "some definite micrometric integer should be assumed, being a determinate part of unity." He suggested as a name for this integer that it be called a micro line, and thought that a good provisional standard would be the 1-10000 of an English inch, but his preference was for a decimal scale.

No action seems to have been taken in the matter at that time or since. We are as far from a definite standard to-day as we ever were, and unless the question is taken up in good earnest by able and well-known men, representing in some way the microscopists of the country, either as delegates from societies to a convention like this, or at a special meeting for the purpose, it will be as it is now for years to come.

If we pretend to scientific accuracy in our work, we must have reliable micrometers; and if we desire to avoid trouble in reading the results of the labor of others, we must all use the same unit of measurement. Decisive action taken now will make this convention remembered for years to come, and the actual, practical benefit to microscopists will be more than we now appreciate. If well chosen, our standard will be adopted by other countries, and we have a good opportunity now to make this Congress remembered in the history of our science.

After recommending the stage micrometer as the form best adapted for general use, Professor Hitchcock referred to a plan suggested by Professor Rogers, who proposes that five of the leading microscopical societies in the country act in concert and appoint a committee to decide upon one uniform standard. He then promises to place in the hands of such a committee six standards, consisting of fifty spaces, covering exactly one-twelfth part of the standard British yard at Washington. Each of these spaces would be divided into ten equal parts, thus giving five hundred lines. These lines would be one one-thousandth of an inch apart.* Professor Hitchcock continued as follows:

Professor Rogers is now having a new machine made which he has reason to believe will enable him to do better work than the one he is now using. Even with the one he now has he can arrive very near the truth. He believes he can rule one hundred micrometers just alike.

We can all realize that it has required a great deal of patient observation and experimenting to arrive at this result, as well as a considerable outlay of money. If we have here a man who has done so much in perfecting a means of microscopical measurement, we surely should be glad to show our appreciation of his work by appointing competent men to test it and report their results. This, however, may be done more systematically by particular societies, as Prof. Rogers has suggested. Leaving this part to the societies, then, it is for us to determine what the standard shall be, and I have some suggestions to offer on this subject.

We are accustomed in this country to employ the divisions of the inch. As a rule people are conservative. If before this subject is properly discussed a vote were to be taken, I think the chances are we would nearly all vote for the inch in preference to anything else. But in a case like this custom must not govern us. We decide this question not for ourselves alone, but for future generations. The action of this Congress will be known throughout the world, and its influence must be felt. It becomes us, then, to act carefully and with the best judgment.

We propose a standard for universal use; then let us select one that can and will be adopted, not by our own country alone, but by all civilized nations. We must not allow considerations of economy to actuate us, nor of mere convenience. Therefore, I say, let us select the French system as our basis of measurement.

It is not for me to indicate to this audience its advantages as a system of measurement for universal use. I do not even say that I believe it is the best. But I do say that it is the only system that can be made universal in a micrometer for the microscope, and in this I expect the support of all who are familiar with scientific work throughout the world. To those who are in doubt as to this, it is sufficient to remind them that a nation like France, which has used a decimal system so long, could not be expected to change it to one with divisions like our inch. We should be ready to sacrifice something ourselves (and it will be at most a sacrifice to us for a short space of time) for the sake of securing unity with the people of a whole country. It would be otherwise if our system of measurement were superior to the French, for then we might ask them to conform to ours, but as it is far inferior we should not ask for such a concession from them. Moreover, even in our own country the inch standard cannot be maintained, for scientific men are decided in their preference for the French system. When I say that this Congress has the power to make a standard for the country, I mean that this standard shall be made to suit the requirements of men of science. Practically we are forced to the adoption of the French system, by the demands of our own workers. I have not been able to collect statistics as to how many of our educational institutions are now using the millimetre micrometers, but I know that many of them are, and I know too, that a chemist can hardly be found who measures in quarts and pints and gills, or who weighs in grains. It is always c. m. and grammes, and if this Congress means to do a good work, it would do well to adopt the millimetre as its standard for subdivision.

The time is ripe for it, and we must either assert ourselves as ready to meet the demands of the time in which we live, or be relegated to the age of conservatives. They are out of date among scientific men.

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*There is evidently an error in these calculations, but we are unable at present to point it out.

It is wonderful how science is progressing, and still more wonderful it is when we think how few are doing the work.

In all this large assembly how few are really scientific workers. And yet our science is advancing, and we, who from our number, hold the balance of power, can do nothing better, it seems to me, than to meet or anticipate the wants of the few who add the treasures to our storehouse of knowledge.

The other paper upon this topic, by C. M. Vorce, was entitled "A Handy Rule for Use in Micrometry," and described minutely a method which the author had found useful in his own microscopic study.

President Ward followed with some remarks on matters of a kindred nature. He exhibited to the Congress a minute wheel with cogs, which, however, were so small as to be almost invisible. He stated that it was an illustration of the exact nicety which had been reached by the naked eye, as this exquisite piece of mechanism was made with almost microscopic exactness without the use of a microscope. It was also a proof of the wide differences that exist in the power of the human eye.

The morning session closed with an address by Prof. J. D. Hyatt, of New York, who explained and illustrated with diagrams the sting of the honey bee. The illustrations were greatly admired for the care and study which had evidently been bestowed upon their preparation, and for the exquisite taste displayed in the coloring to represent nature. Unfortunately, Mr. Hyatt's address was not in manuscript.

The afternoon was pleasantly occupied in an excursion over the Belt line, and a visit to the stockyards. All the principal manufactories along the line of route were pointed out to the delegates as they passed, and many of the gentlemen expressed their gratification at thus having the opportunity of learning something as to the extent, the character of the surroundings, and the business enterprise of the city of Indianapolis. The party were accompanied by a number of prominent citizens and many ladies. Thanks are due to Mr. Averill, of the Terre Haute line, Mr. Scott, superintendent of the Belt railroad, and Mr. Downey, superintendent of the stockyards, for courtesies extended in arranging for the excursion. The trip occupied a little over three hours.

The evening was devoted to a *soiree*, which the *elite* of the city attended; to say say that there was a crowd would but feebly express the case. About forty instruments were in use, and the objects shown were mostly of a popular nature. Every one seemed well pleased, although the crowd was so great as to seriously interfere with comfort.

At the close of the *soiree* an informal meeting of some of the delegates was held at a room on Washington street, and questions of angles, oil fronts, screw collar adjustment and allied subjects were ably discussed at length by such gentleman as Prof. Smith, Dr. Blackham, Messrs. Fell, Fuller, Bausch, Fisher, Atwood and others, and if no new points were developed, the participants will always remember this as one of the pleasantest meetings of the whole series.

FOURTH DAY.

The fourth and last day of the Congress was a busy one. The report of the committee on permanent organization was first in order. After considerable debate and some little differences of opinion having been expressed, it was adopted, as follows:

Provisional Constitution for the year 1878–9, *adopted August* 17, 1878, *at Indianapolis, Ind.*

ARTICLE 1. *Name.* This organization shall be called "The American Society of Microscopists."

ART. 2. *Objects.* The objects shall be the encouragement of microscopical research in all branches of science, by meetings, discussions, demonstrations, and the reading and publishing of papers.

ART. 3. *Membership.* Any person interested in microscopical science is eligible to membership, and may become a member of the society upon recommendation in writing by two members, nomination by the Executive Board, and election by a majority of the members present at a regular meeting.

ART. 4. *Officers.* The officers shall consist of a President, two Vice-Presidents, Secretary and Treasurer, and shall hold office for one year, or until their successors are elected and qualified.

ART. 5. *Executive Board.* The Executive Board shall consist of the officers of the society, and the past Presidents, with three members elected from the society.

ART. 6. *Meetings.* The place of the next meeting in each case shall be determined annually by ballot at the same time and place as the election of officers.

ART. 7. *Election of Officers.* The election of officers shall be held on the morning of the last day of each meeting, in the following manner, and they shall be installed on the afternoon of the same day. The election shall be by ballot, without nomination. In case there is no choice on the first ballot, all the candidates, except those two having received the highest vote (and in case of a tie, three), shall be dropped after the first ballot. A majority of all the votes cast shall be necessary to a choice.

ART. 8. *Duties of Officers.* The duties of the officers shall be the same as in other similar organizations. In addition it shall be the duty of the President to deliver an address at the opening of the meeting over which he presides.

ART. 9. *Fees.* The dues shall be $2.00, paid annually in advance. The initiation fee shall be $3.00. No applicant shall be considered a member until he has paid his dues and signed the constitution.

R. HITCHCOCK, Sec. Gen. Com.

The General Committee recommended that a committee of the Congress be appointed to revise this constitution and report at the next meeting, and that the Executive Board act for the present year as a committee on publication.

On account of some of the members of the Congress having returned to their homes before the new society was organized, it was voted that all members of the Congress shall become members of the "American Society of Microscopists," by signing the constitution and paying their dues.

The Executive Committee was constituted the Committee on Printing and Publishing, and charged with the duty of obtaining the publication of the proceedings of the Congress in one of the scientific papers in as complete form as practicable.

The election of officers was proceeded with, and resulted as follows:

President—Dr. R. H. Ward, Troy, N. Y.

Vice-Presidents—S. W. Dennis, San Francisco, Cal.; C. M. Vorce, Cleveland, O.

Secretary—Dr. Henry Jamison, Indianapolis, Ind.

Treasurer—H. F. Atwood, Chicago, Ill.

Dr. Geo. E. Blackham, Prof. J. Edwards Smith and Dr. Atkinson were elected to serve as an Executive Committee in addition to the other officers.

It was determined that the meeting of the association in August, 1879, be held at Buffalo, N. Y., and that an attendance of twenty-five members constitute a quorum.

Rev. A. B. Hervey, in a neat speech, proposed the following resolution of thanks, which was adopted:

Resolved, That the members of this Microscopical Congress desire to express their very hearty thanks to the local committee for inviting them to this friendly and learned conference; to the citizens generally, who have so cordially welcomed us to their homes, and entertained us with such generous hospitality, and the public officers for giving use of their building, and proprietors of hotels; to the railroads which have given us facility of transportation, and offered us an elegant excursion about this noble city; and last, but not least, to the enlightened and enterprising press of this city, which has done so much to introduce the Congress to public attention and awaken a lively interest in the same, and to spread its proceedings before the large reading public.

There still remained a number of papers to be read, but the time was so short that some of them could be read by name only. The list was as follows:

"On Oculars," by W. H. Seaman, Washington, D. C.

"On Micrometer Rulings," by Prof. J. Edwards Smith.

"On a New Turn-table," by Mr. Sidell, of Philadelphia.

"On a New Arrangement for Dark Field

Illumination," by Mr. Lighton, of Ottumwa, Iowa.

"On an Analyzing Eye-piece," by the same gentleman.

"On Riscoe's Section-cutter," by Dr. R. H. Ward.

"On Seiler's Section-cutter," by W. H. Walmsley.

"On Epithelium," by Dr. W. H. Atkinson.

The following resolutions were proposed by Prof. Hitchcock, and adopted, after which the Congress adjourned:

Resolved, That this Congress, representing the various microscopical societies and microscopists of the country, recommend and adopt, for universal use, from this time forth, the 1-100 of a millimetre as our unit of micrometry.

Resolved, That we request each society of microscopists to formally approve our action in this matter, and to request that all authors of papers conform to these resolutions whenever practicable, and that they communicate whatever action they may take to the New York Microscopical Society.

Resolved, That we request microscopical organizations of all countries to formally adopt this same unit, and communicate their action to the same body.

Resolved, That we recommend the plan of Prof. W. A. Rogers for deciding upon a micrometric standard of division to the favorable consideration of the societies.

Taken all in all, the American microscopists have reason to be proud of this their first meeting, and from the success achieved and gratification felt by the participants, it is fair to predict a much larger attendance at Buffalo next year. Some of the serious obstacles which militated against the initiatory meeting have now been removed, and success assured tends to still greater success. And to those unfortunates who, for various reasons, were deterred from attending this meeting, we can only say that it was their loss, but we hope to see them all at Buffalo.

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—Portugal has but one university, Coimbra, founded in 1290. It has 70 instructors, and 1,100 students. There are 2,450 elementary schools, and parents whose children cannot read and write by 15 lose their political rights.

Angular Aperture.

BY PROFESSOR ABBE, OF JENA.

It is well known that the distinguished Professor Abbé, of the University of Jena, has in preparation a treatise upon the "Theory of the Microscope," the appearance of which has been delayed by accidental causes. He has, however, presented a resumé of his views in a series of valuable articles which have appeared during the past season in the French *Journal de Micrographie*.

In one of the later of these articles he has given a succinct synopsis of his conclusions in regard to angular aperture, which, in view of the discussion of the subject in our own columns, we take much satisfaction in presenting to our readers. The Professor says:

"Since it is very important, first of all, to determine the actual facts regarding the action and effect of angular aperture, more definitely than has yet been done in micrographic literature, I have set myself the task of determining by experiment the cases in which a manifest advantage results from the larger angular aperture, and the cases in which no such advantage can be discovered, after carefully eliminating all the differences which might influence the manipulation. To this end, a series of objectives, differing greatly in focal length and in angular aperture, have been constructed with greatest care and upon my own formulas. Their accuracy has been specially tested, in order to obtain a definite degree of certitude when comparing observations made with them. The test objects employed were scales of different kinds of insects, frustules of diatoms, striated muscular fibre, diamond-drawn lines on glass, groups of lines on silvered glass, finely and coarsely pulverized substances, and especially minute optical images of natural objects (network and trellises) obtained by means of air-bubbles, or, still better, by the aid of objectives of small focal length fixed in the stage of the microscope.

"These experiments have given the following results:

"1. When the aperture of the objective is sufficient to prevent any sensible diminution of the fineness of the image from the effects of diffraction, there is no appreciable modification of the details and outlines of the object (that is to say, the lines bounded by parts which are unequally transparent), so long as these parts are not smaller than the 1-2500th of an inch.

"2. On the other hand, the difference is altogether in favor of the larger aperture for every object which presents details smaller than the limit above given: and this is altogether independent of the question whether these details are due to inequalities of surface, to differences of transparency in infinitesimally thin layers, or to the fact that they have the form of striations, granulations, cross-hatching, or are the images of natural objects reflected by air-bubbles or produced by the refraction of lenses.

"3. The smaller the linear measurement of these details may be, the greater must be the angular aperture of the objective, if they are to be studied with one of the prescribed methods of illumination, viz., exactly central or very oblique light; and this conclusion is independent of the more or less marked character of the outlines, of the focal length, or of the necessary magnifying power of the objective.

"4. When the markings of a real object take the form of striations, groups of lines, etc., a given angular aperture always gives finer details, with oblique illumination than with central; and this is independent of the question whether the nature and form of the object admits or entirely excludes the possibility of the effects of shadow.

"5. A structure of the kind I have supposed, which cannot be resolved by central light, will not be better seen by inclining *the object itself* at an angle to the axis of the microscope, even when, if placed flat at right angles with the axis, it is perfectly resolved by oblique light. Nevertheless, resolution will be had if the incident light be directly perpendicularly to the plane of the object, this plane being inclined at an angle to the axis of the instrument. It thus appears that the additional effect of oblique illumination depends solely upon the inclination of the rays to the axis of the microscope, but *not* upon an oblique angle of incidence of the light upon the object.

"The facts above set forth have established on the one hand the real existence of a special optical quality, in direct relations with the *angle of aperture* of the objective, but independent of any special perfection of construction, or of the amplifying power which it may have; and they further show that we are dealing with a power of "resolution," or a capacity to separate the fine details of an object, as indeed the literal sense of the term denotes."

Prof. Abbé then enters into an interesting, though somewhat abstruse discussion of the basis of the resolving power of the objective, and of the theory of diffraction phenomena with which it is associated. We may, at a future time, lay a synopsis of this before our readers.

Paste Eels.

IN reply to a correspondent who asks how paste eels may be raised, one of our scientific cotemporaries says that paste, if left to turn sour, will soon swarm with these curious little creatures. The directions usually given are to boil flour and water, as in making ordinary paste, and set it aside until it becomes sour, stirring it occasionally so as to prevent the growth of mould. We have tried this plan over and over again, and have never succeeded once. We have kept the paste until it had passed through all stages of decay, but never, under ordinary circumstances, have eels made their appearance. And, indeed, it would evidently have been impossible to find them, unless they had either been developed by spontaneous generation, or the eggs or germs had been carried through the air. That they could be developed by spontaneous generation, few will believe, and that their eggs or germs are ever carried by the air, we have abundantly disproved by the following experiment: A jar of paste without eels was placed in the centre of six jars containing paste which seemed to be almost alive with them; these seven jars were allowed to stand for weeks, the only addition being a little well boiled (and cooled) water to keep the paste from drying up. Under these conditions the eels in the outer jars throve until the paste seemed to be literally a mass of eels and nothing else. But in the central jar no eels ever made their appearance.

The question arises then, How do the eels ever originate in paste, unless when placed there by design? The only solution that we have found to this question is that they come there from the water used to dilute the paste. It very frequently happens that river, pond or cistern water contains small eels very similar to the paste eel, and it is more than probable that these eels, developing rapidly in the new conditions in which they are placed, cause the paste to swarm with their progeny. Those, therefore, who desire to raise a stock of eels, must, after making the paste, add to it a little water from the bottom of a pond or cistern. In this way a start may often be obtained. But to merely expose a lot of boiled paste to the air until it becomes sour will in almost all cases end in failure. The easiest method, however, is to obtain from some friend a little paste containing eels, and add this to some paste that is three or four days old. The paste should be well mixed, and stirred daily to prevent the growth of mould.—*Young Scientist.*

Pond and Stream.

OF all objects for microscopic study, there is nothing in my estimation to compare with the living objects of pond and stream. They will furnish more beautiful and interesting objects than the most complete cabinet. To this department the microscope should be more particularly devoted.

There is no question that from this kind of inquiry more important results may be obtained than from any other. Here it is not necessary to diverge from the main object (observation) to dissect, cut, slice, grind or polish, before you can examine, all of which requires abundance of leisure time, and cannot be very interesting as it is only a means of getting an object for examination, unless making a special study of an object.

Pond and stream life furnishes work for both high and low angled lenses, penetration or no penetration. It is a magnificent sight to get a rhizopod (*Difflugia proteiformis*), or a diatom (*Gomphonema elongatum*) drift across your field under a 180° lens; they sparkle like a Koh-i-noor, and then under a comfortable working lens, like the inch of 25° or 30°, take a survey of your pasture.

How interesting, under a low power, to get a diminutive view of some rare object or peculiar action, and then bring the matter up clear and enlarged with a higher power. How vastly easy is microscopical analysis in comparison with chemical! With the microscope the imperceptible is made perceptible at once; the chemical requires great labor and time. H. WATSON

Providence, R. I.

How to Silver a Mirror.

TO such of the readers of the JOURNAL OF MICROSCOPY, who, like the writer, live remote from the great commercial and industrial centres, and who are consequently frequently compelled to rely on their own mechanical skill and ingenuity, or their own technical knowledge, in emergencies where their more fortunate brethren can call to their aid the services of skilled mechanicians and instrument makers, the following will prove interesting and valuable.

A short time since minute specks began to show themselves in the mirrors, both plane and concave, of my Nachet microscope, and soon both became worthless as reflectors. Upon examination I found that the varnish protecting the amalgam had cracked into numberless little fissures, and the amalgam itself had become detached from the glass. Compelled to use my instrument almost every day, professionally, while it would require from two to three weeks to send off to have the damage repaired, I determined to resilver the mirrors by one of the processes now in general use in the arts and sciences, and of which to a certain extent, I had my choice.

While a student, several years ago in the laboratory of Baron von Liebig, in Munich, I assisted in conducting a series of experiments looking to the manufacture of silvered mirrors on a large commercial scale (with a view of doing away with the mercurial amalgam process, which pernicious industry was then attracting general attention in Bavaria), and by the use of the Liebig method, and what was afterwards known as the Siemen's modification of the same, had succeeded in making some exquisite mirrors of a large size and almost perfect reflecting surface. Where *ammonium aldehyde* ($C^2 H^3 (NH^4) O$) can be obtained, there is no doubt that this is the best and most economical process, whether used on a large or a small scale.

The next best process is based upon the reduction of metallic silver from its ammoniacal solution by salts of tartar. Having tried several formulæ of this kind, all of them more or less simple, as well as efficacious, I have found the following to yield the best results in the shortest time.

Silvering Solution.—In 1 ounce of distilled or pure rain water, dissolve 48 grains of crystalized nitrate of silver. Precipitate by adding strongest water of ammonia, and continue to add the ammonia drop by drop, stirring the solution with a glass rod, until the brown precipitate is nearly, but not quite, redissolved. Filter, and add distilled water to make 12 fluid drachms.

Reducing Solution.—Dissolve in 1 ounce of distilled or very clean rain water, 12 grains of potassium and sodium tartrate (Rochellé or Seignette salts). Boil, in a flask, and while boiling add 2 grains crystalized nitrate of silver dissolved in 1 drachm of water. Continue the boiling five or six minutes. Let cool, filter, and add distilled water to make 12 fluid drachms.

To Silver.—For a mirror 1¼ to 1¾ inches in diameter, take an ordinary two-ounce graduate glass; procure a piece of thin wood (cigar box will do) long enough to go across the top of it, and through the centre of the wood thrust, as shown in Fig. 1, a wire seven or eight inches long. After cleansing the glass to be silvered by immersing it in strong nitric acid, washing in liquor potassæ, and thoroughly rinsing with distilled water, with a bit of sealing wax attach one end of the wire to its face, as in Fig. 1. If the glass has had mercurial amalgam on it, it will probably be necessary to clean the back with rouge. On having this surface perfectly, chemically clean, depends in a great measure the success of the operation.

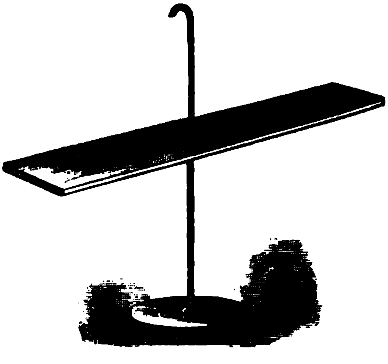
Fig. 1.

Having attached the glass to the wire, lay the strip across the graduate, move the glass disc downwards until it nearly, *but not quite*, touches the sides of the graduate all around, taking care that its edges shall be as nearly level as possible. Having ascertained the height in the graduate at which the disc should stand, bend or clamp the wire so that it cannot slip. In the ordinary American graduate, with a mirror 1¾ inches diameter, this will be at the 6-drachm mark, as nearly as may be. Remove the glass and pour into the graduate enough of equal quantities of the two solutions to fill the graduate exactly to the previously ascertained level. Stir the solutions so that they will become thoroughly mixed, and replace the disc to be silvered, taking great care that the surface to be silvered shall come in contact with the silvering fluid exactly at all points. The disc should be rinsed carefully before replacing, and should be put in while wet. Great care should be taken that no air bubbles remain on the surface of the solution, or between it and the surface to be silvered.

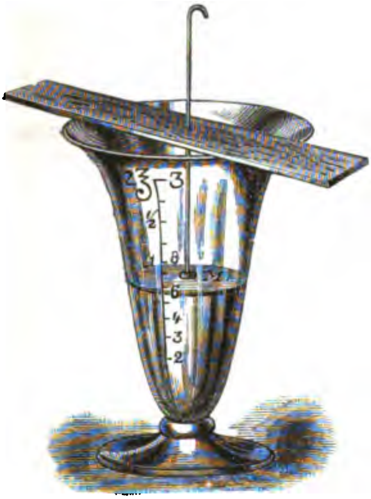

Fig. 2.

Now set the graduate in the sun for a few minutes, if the weather be warm, or by the fire, if it be cold, as a temperature of 45° to 50° C. (113° to 122° Fah.) is most conducive to the rapid deposition of a brilliant, firm and even film of silver. The fluid in the sunlight soon becomes inky black, gradually clearing as the silver is reduced, until when exhausted it is perfectly clear. The mirror should be removed before this point is reached, as a process of bleaching sets up if left after the fluid is exhausted. From 20 to 80 minutes, according to the weather, purity of chemicals, etc., is required for the entire process.

When the mirror is removed from the bath, it should be carefully rinsed with distilled water from the wash bottle, and laid on its edge on blotting paper to dry. When perfectly dry, the back should be varnished with some elastic varnish and allowed to dry. The wire and sealing-wax can now be removed from the face, and the glass cleaned with a little fledget of cotton and a minute drop of nitric acid, taking great care that the acid does not get to the edges or under the varnish. Rinse, dry and the mirror is finished.

The light reflected from a mirror made thus has somewhat of a yellowish tinge, but photometric experiments show that from 25 to 30 per cent more light is reflected than from the old mercurial mirrors.

FRANK L. JAMES, PH. D., M. D.
Osceola, Ark., Aug. 3, 1878.

A Story of Science.

BY ONE WHO KNOWS NOTHING ABOUT IT.

A philosopher sat in his easy chair,
Looking as grave as Milton;
He wore a solemn and mystic air
As he Canada balsam spilt on
A strip of glass, as a slide to prepare
For a mite taken out of his Stilton.

He took his microscope out of his case,
And settled the focus rightly:
The light thrown back from the mirror's face
Came glimmering upward brightly.
He put the slide with the mite in place,
And fixed on the cover tightly.

He turned the instrument up and down,
Till getting a proper sight, he
Exclaimed—as he gazed with a puzzled frown—
"Good gracious!" and "Highty-tighty!
The sight is enough to alarm the town—
A mite is a monster mighty!"

From t'other end of the tube, the mite
Regarded our scientific,—
To its naked eye, as you'll guess, the sight
Of a man was most terrific,
But reversing the microscope, made him quite
The opposite of magnific.

"One sees the truth through this tube so tall,"
Said the mite as it squinted through it,
"Man is not so wondrously big after all,
If the mite-world only knew it!"

MORAL.

MEM.—Whether a thing is large or small
Depends on the way you view it!

Fun.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

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As we desire to place a COMPLETE set of the Journal at the disposal of our subscribers at a moderate rate, We offer Vols. I and II, bound, and Vol. III in numbers as issued, for $2 50 *net*. These who wish to have their numbers of either Vol. I or Vol. II bound can do so for 35 cents. Postage 10 cents additional.

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorised to receive subscriptions and advertisements:

MR. CHARLES STODDER, 131 Devonshire Street, Boston.
S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 48 Madison St., Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

The January Number.

THE number of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878, is entirely out of print, and we can no longer supply it to subscribers.

We will gladly pay ten cents apiece for clean copies of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878.

Extra Numbers.

IT is our purpose to issue from time to time extra numbers, containing either finely illustrated original articles or reproductions of articles which have appeared in European journals. Each of the numbers containing these articles will form one of the regular series issued to subscribers; each one will be complete in itself, and a fair specimen is to be found in our last issue, which contained Rev. W. H. Dallinger's paper on septic organisms, illustrated by two plates.

But while, to our regular subscribers, we make no extra charge for these numbers, we cannot afford to sell them singly at the low rate which we charge for ordinary copies. Purchasers of single copies will please make a note of this. The price will be found marked on each number. Our regular subscribers will receive all the numbers issued during the year without any additional payment being required.

Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

A Card from Mr. Gundlach.

Ed. Am. Jour. Microscopy—In the June number of your journal, I find an article describing a new cover-adjustment invented by me. I am rather surprised to see that this article is, with a few alterations, a true translation of an article which was written by me. I have not given the German manuscript of it into any other hands, than only to Mr. Schramm, the Secretary of the Bausch & Lomb Optical Company, for translation, and after severing my connection with the said company I received it back from him, when he wrote me that he had not translated it, nor a part of it.

Also, to nobody have I given permission to publish the article, as I intended to do so myself.

The latter I should now find unnecessary, if you would have the kindness to issue in the next number of your journal this letter, and the following completion to the said article:

"I have recently made a further improvement of my new adjustment, consisting of a contrivance which keeps the object constantly in focus while adjusting."

ERNST GUNDLACH.

Rochester, July 9, 1878.

[As the foregoing contains a somewhat serious charge, we have deemed it but just to publish Mr. Schramm's reply at the same time.—ED. AM. J. M.]

Mr. Schramm's Reply.

Ed. Am. Jour. Microscopy—Having been permitted, by your kind courtesy, to see the proof of a letter or card, from Mr. Ernst Gundlach, addressed to you, relative to an article descriptive of a new cover-adjustment, patented by him some time ago, I avail myself of the privilege which you kindly accord to me to offer the following explanatory remarks. The article in question, which I furnished you, is not a translation, in the usually accepted sense of the term, of any article written by Mr. Gundlach. When I wrote that article, the one Mr. Gundlach refers to had long passed out of my possession. There is, however, doubtless and naturally an unavoidable similarity between the two articles, for they describe the same object and state the same views- Mr. Gundlach's views—which he imparted to me at various times and in various ways, and which I accepted and hold as my own. I may also state that a very large portion of the article may be found in the patent specifications now on file in Washington, and open to the inspection of any one. These specifications were drawn by me from data furnished by Mr. Gundlach.

I am not aware that I have been guilty of any moral or legal offence in stating these views publicly, nor did I think it required any special permission to publish them, being under the impression that the acquisition of the patent rights of the invention by the Bausch & Lomb Optical Co., included the privilege of bringing the article manufactured under such patent, to the notice of the public in the most favorable manner. It seems, however, from the remarks of Mr. Gundlach and from his advertisements, that he either ignores, or has forgotten the fact that he no longer owns the patent nor any share in it.

G. W. SCHRAMM,
Secretary Bausch & Lomb Optical Co.
New York, Sept. 12, 1878.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Aug. 15, Prof. Ashburner, in the regretted absence of Mr. Hyde, taking the chair for the evening. As visitors, there were present Messrs. C. Wolcott Brooks and S. N. Felton, and Drs. F. A. Holman and James P. Whitney, of San Francisco; Mr. Samuel Williams, of Oakland; and Mr. A. Y. Moore, from Coldwater, Michigan.

The current numbers of the "Quarterly Microscopical Journal," "Cincinnati Medical News," "American Naturalist," "Popular Science Monthly and Supplement," and the AMERICAN JOURNAL OF MICROSCOPY were added to the library.

Mr. Clark exhibited slides of gold washed from the sands below the Ocean House, which have recently attracted so much attention. He said that the particles of gold were of a peculiar saucer-shape, oval in outline, with an average long diameter of five thousandths of an inch, and an average thickness of one thousandth of an inch. The small size and peculiar shape may be attributed to the long distance they have been carried, all but the most buoyant particles being left behind by a process of gradual segregation.

Mr. Clarke also spoke briefly of the microscopic fossils—diatoms, foraminifera, serpulas, poriferæ, minute mullusca, mellita spines and plates, and crustacea—found in the earths obtained by boring to great depths, near the mouth of the Mississippi, by Capt. Eads, U. S. A. A slide was shown; also the engravings which are to accompany Prof. E. W. Hilgard's report upon these fossils in the Government publication relating thereto.

Much pleasure was given by the presence of Mr. Allen Y. Moore, for some time a correspondent with the Society; and his slides of arranged diatoms, young fish, lignite in section, Challenger diatoms, and double stained vegetable sections, were eagerly examined.

Dr. J. P. Whitney read a long and abstruse paper on "The Origin of Life," of which it is possible to report here only the salient points. Starting with the diffused cosmic vapor, he showed how, by its condensation, suns and planets were formed, and how the planets gradually reach the condition which makes life possible. The question then is, whence comes this life? The simplest form of life we know is the structureless moner, composed of protoplasm. Dr. Whitney's thesis is ‘ [illegible] all the constituents of protoplasm, hydrogen, oxygen, nitrogen and carbon, exist both in the air and in sea water, they are there combined by the action of sunlight, forming in the air those innumerable germs which Tyndall has shown to there exist, and in sea water, the Bathybius—the true Bathybius, for whose non-existence there is only negative evidence. The difference between Dr. Whitney's views and those held by most evolutionists, Spencer, for instance, seems to be that instead of regarding the extremely complex compound, protoplasm, as the result of a series, long in number and in time, of organic compounds combining and recombining, he asserts its immediate, or nearly immediate, formation from its elements in the air and sea water. Still further, he considers the protoplasmic life thus originated to be the germs that on development are the lowest forms of life we know, whereas, Spencer, for instance, says: "I conceive that the moulding of such organic matter into the simplest types, must have commenced with portions of protoplasm more minute, more indefinite, and more inconstant in their characters than the lowest rhizopods, less distinguishable from a mere fragment of albumen than even the protogenes of Prof. Haeckel."

It must have been a long time in this gradual progress of life before there were reached organisms of such complexity as is implied by origin and development from a germ. Dr. Whitney devoted his paper to the stating, rather than the substantiating of his thesis. After an animated discussion, the Society adjourned.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 186 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of corn smut, spicules, and lepidoptera scales of various kinds, in exchange for other well mounted objects; transparent and for low powers preferred. Arthur Hobart, Box 581, Penn Yan, Yates County, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and Carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of mauzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Magic lantern, nine slides (two mechanical) in complete order, in exchange for good compound microscope. T. R. Barwood, Flatbush, L. I.

Wanted, microscope, or scientific and mechanical books and apparatus, in exchange for printing press, cost $21, with or without type and material. J. P. Burbank, Salem, Mass.

Fig 1

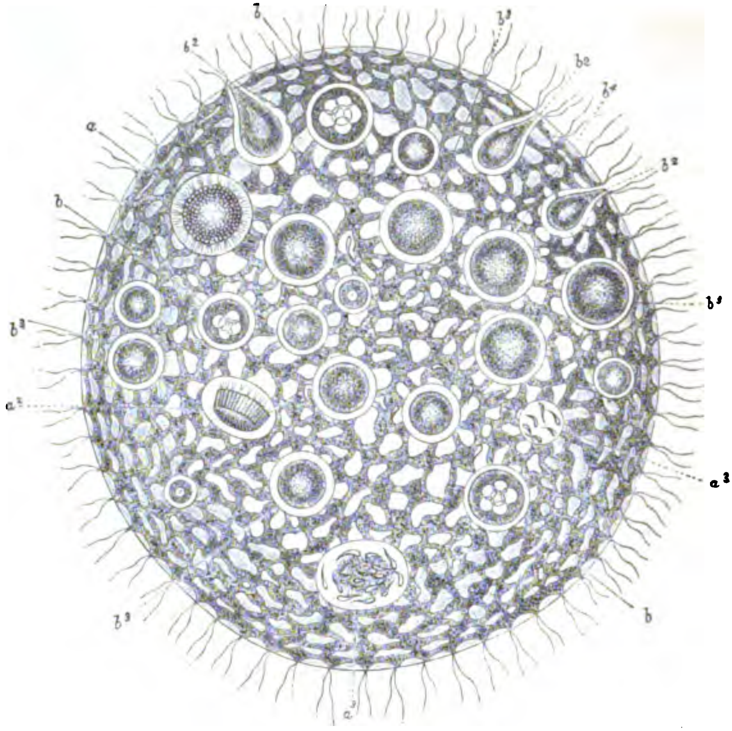


Fig 3

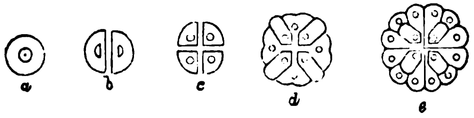
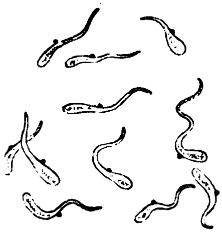


Fig 5



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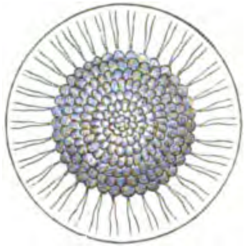


Fig 6

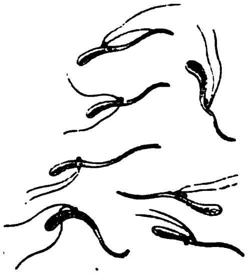


Fig 2

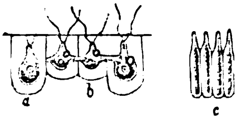


Fig 7

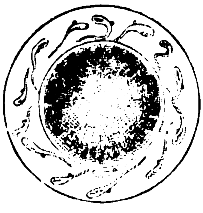
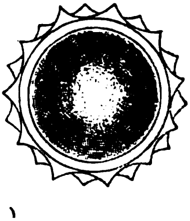


Fig 8



VOLVOX GLOBATOR. (After Cohn.)

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. III. NEW YORK, OCTOBER, 1878. No. 10.

Volvox Globator.

BY ALFRED W. BENNETT, M.A., B SC., F L.S.

THE organism which we are about to describe has long been a favorite object for observation to microscopists, not only from the extraordinary beauty and delicacy of its structure, but from the remarkable phenomenon which it presents of a member of the vegetable kingdom endowed with a power of motion apparently as spontaneous as that possessed by any organisms belonging to the animal kingdom. The very location of the *Volvox* among plants has indeed been challenged. Like many others which are now placed, by almost universal consent, among the lower classes of Cryptogams, it was held by the distinguished naturalist, Ehrenberg, to be of animal nature. If, however, any doubt remained as to its true vegetable character, this has been completely set at rest by the researches of Professor Cohn,* who has only quite recently for the first time followed out completely the various stages of reproduction of this singular organism. In no English work will they at present be found adequately described, although so many observers had before his time had it under their notice.

The *Volvox globator* is not uncommon in clear pools on commons, and in similar situations, and is visible to the naked eye as a minute pale-green globule rolling through the water, passing rapidly across the field of view under the microscope, its full diameter being perhaps one-fiftieth of an inch. Under the microscope it is seen that the rotatory motion is caused by innumerable fine transparent vibratile cilia, with which the surface is studded. The appearance presented by the entire body is that of a globular transparent, hollow membranous sac, through which these cilia protrude, and studded with bright green points, while in the interior are seen a small number of dense green globes. In the autumn or early winter these internal globes have often assumed an orange color, giving to the whole globule a red tinge. The vibratile cilia already described are arranged in pairs, each pair belonging to a separate peripheral corpuscle or cell. These peripheral cells contain each a green protoplasm-body, varying in shape according to the age of the individual, as shown in Fig. 2, *a*, *b;* they usually contain a minute starch granule, a reddish-brown "eye-spot," analogous to that of swarm cells

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* "Beiträge zur Biologie der Pflanzen," Vol. I, heft 3, 1875.

(zoospores) and of the Flagellate Infusoria, and one or two contractile vacuoles, the cilia being borne at the narrow hyaline end. Each is surrounded by a gelatinous envelope, which is pierced by a number of canals, all lying nearly in one plane, and filled by green or colorless extensions of the protoplasmic interior. Since the canals of adjoining cells correspond, the corpuscles appear as if connected together by a network of fine reticulations. The outer gelatinous wall of each cell is also perforated by two pores, through which the two vibratile cilia protrude into the surrounding water. They constitute a single peripheral layer enveloping the entire organism, corresponding to the plate which is characteristic of many Chroococcaceæ; each one by itself would be undistinguishable from an ordinary swarm cell of many filamentous Algæ, or from the entire individual of *Chlamydococcus* or *Pleurococcus* in its motile stage. They have, however, so far as is known, no reproductive function, and in this respect stand almost alone among cells endowed with a spontaneous power of motion.

Besides these non-reproductive or sterile cells, there are in each *Volvox* colony three kinds of reproductive cells—non-sexual (neuter), male, and female. The neuter reproductive cells, or parthenogonidia, as Cohn terms them, are similar in structure to the sterile cells, but two or three times their size, *i. e.* from .006 to .009 mm. in diameter. Very early in the development of the young colony they begin to multiply by bipartition, and all the cells in the same colony or sphere are usually at one time in the same stage of development. This division has been followed by Cohn through four stages, as shown in Fig. 3, *a–e*, the fourth stage consisting of sixteen cells, beyond which he was unable to trace it, owing to the difficulty of the observation. At this stage it is described as having somewhat the form of a blackberry, each segment possessing a single chlorophyl-granule containing starch. The young colony is surrounded by a transparent membrane, which it at length breaks through, and carries on an independent existence within the cavity of the mother colony, each of its cells developing a pair of cilia; finally it escapes from its confinement in the mother colony into the surrounding water. The normal number of parthenogonidia which thus develop into colonies within the mother colony is eight, corresponding to the eight cells into which each of them breaks up on its third segmentation. The young colonies complete their growth in a few days, attaining a diameter of from 00.10 to 00.15 mm., and have by this time absorbed the greater part of the chlorophyl and starch of the mother colony.

The sexual reproductive cells, male and female, are very few in proportion to the sterile cells. While the non-sexual reproduction by parthenogonidia takes place during the whole year, the sexual cells are apparently formed only in the autumn. The two kinds are found either in the same or in different colonies, establishing the classification of the genus into monœcious and diœcious sub-species, as first pointed out by Cohn. Fig. 1 represents a monœcious colony. The two modes of reproduction do not take place simultaneously in the same colony, the sexual generation forming the close of a longer or shorter series of non-sexual generations. *Volvox* presents, in fact, one of the earliest instances in the ascending series of the phenomenon known as alternation of generations, which attains its highest development in plants in the Vascular Cryptogams. The female cells (gynogonidia of Cohn) are at first undistinguishable from the parthenogonidia, but are much more numerous. On their first appearance they are about three times the size of the sterile cells; their protoplasm body increases rapidly, and becomes of a dark green color from abundance of chlorophyl. They have at first a frothy appearance (Fig. 1, *b*) from the formation of vacuoles, but afterward appear to be filled with protoplasm; and they are now at once distinguishable from the parthenogonidia by their never dividing. They soon become flask-shaped (Fig. 1, b^2), their narrow end touching the periphery of the sphere, and the larger end hanging free into the cavity. When ready for impregnation they round themselves off into a spherical form (Fig. 1, b^3), and may then be designated oospheres, each being enveloped in a gelatinous membrane or oogonium. The male cells, or androgonidia, present at first a still closer resemblance to the parthenogonidia, since, when they have attained about three times the size of the sterile cells, they begin to divide; but they are of a lighter color, from containing a smaller quantity of chlorophyl. The divisions also take place only in two instead of in three directions, thus developing, not into a sphere, but into a plate of cells. They ultimately resolve themselves into a bundle of naked primordial cells (Fig. 1, *a*), each consisting of a thicker but elongated body, in which the chlorophyl has been transformed into a reddish-yellow pigment, and of a long colorless beak, to the base of which are attached two very long vibratile cilia, and where also is a red corpuscle or eye-spot (see Figs. 4, 5, 6). The whole androgonidium may now be considered as an antheridium inclosed in a gelatinous envelope, each of the naked protoplasmic bodies being a motile antherozoid or spermatozoid. About the same time that the gynogonidia have matured into oogonia, and their protoplasmic contents into oospheres, the movements of the vibratile cilia attached to the antherozoids begin to set the whole antheridium in motion, in the positions indicated in Fig. 1, a, a^2; the antheridium soon breaks up, and the separate antherozoids are seen in rapid independent motion within the gelatinous envelope of the antheridium (Fig. 1, a^3), which they ultimately break through, and then move about rapidly in all directions within the cavity of the mother colony. Their movements are described by Cohn as being remarkably beautiful, the constant curvings of the elongated neck of the antherozoid being compared by him to those of the neck of a swan. They assemble in large numbers round the oogonia, and some of them finally penetrate through their gelatinous envelopes (Fig. 1, b^4, Fig. 7), and coalesce with their protoplasmic contents or oospheres. The fertilized oosphere is now an oospore, and develops a new cell wall, the epispore, which is at first smooth, but afterward covered with conical elevations, giving a section of it a stellate appearance (Fig. 8). A second perfectly smooth membrane, the endospore, is subsequently formed within the first. The chlorophyl gradually disappears, and is replaced by an orange-red pigment dissolved in oil, so that the mature oospore, while still inclosed within the mother colony, is of a bright red color, giving the red tinge which *Volvox* often presents, even to the naked eye, at certain periods of the year. Individuals containing oospores still enveloped in their spiny coatings were described by Ehrenberg as a distinct species, under the name of *V. stellatus*. The number of sexual reproductive cells in a colony of *Volvox* varies greatly; Cohn has observed five or more male and about forty female cells.

Soon after the oospore reaches maturity, the mother colony breaks up, single cells escaping from the combination and swimming about freely in the water; their further history is unknown; while the oospores fall to the bottom and there hibernate. Their further development has only been observed by Cienkowski, who states that the contents of each spore break up into eight spheres which ultimately swarm out.

Ehrenberg described two species of *Volvox*—*V. globator* and *V. stellatus*—both of which he considered to be infusorial animalcules. These have been determined by Cohn to be different stages of the same species, the former in its parthenogenetic, the latter in its sexually reproductive condition; Ehrenberg's *Sphærosira volvox* is also another form of the same species. His *Volvox aureus* and Stein's *V. minor* are considered by Cohn to form a distinct subspecies of *V. globator*, differing from the typical form in the colonies being of a smaller size, and diœcious instead of monœcious, and in the epispore of the oospore being smooth. The mode of fertilization of the latter form has not yet been directly observed. The genus is cosmopolitan, having been found throughout Europe, in North Africa, India and North America.

The old family of Volvocineæ, which included the genera *Volvox*, *Eudorina*, *Pandorina*, *Gonium* and *Stephanosphæra*, is placed by Sachs, in the Fourth edition of his "Lehrbuch," under the Zygosporeæ, and in the section characterized by the conjugation of zoogonidia (swarm-spores or zoospores). It is evident, however, that the family, as so constituted, cannot be maintained, and Rostafinski's classification must be accepted as preferable, retaining those genera which exhibit the conjugation of swarm-spores as a family of Zygosporeæ, under the name of Pandorineæ, while the true Volvocineæ are placed in the class of Oosporeæ,* in which the process of impregnation consists in the coalescence of one or more minute spontaneously motile antherozoids, which escape from an antheridium, with a comparatively large oosphere contained in an oogonium. The process indeed bears a very close analogy to the mode of fertilization in one of the highest families of Oosporeæ, the Fucaceæ. The family Volvocineæ, as thus constituted, includes at present only the two genera *Volvox* and *Eudorina*. The structure and developmental history of the latter have been described by Carter.†

EXPLANATION OF PLATE.

Fig. 1. A monœcious colony of *Volvox globator*, *a*, *a2*, *a3*, antheridia; *b*, *b2*, gynogonidia; *b3*, *b4*, oospheres.

Fig. 2. Ciliated peripheral cells.

Fig. 3. *a–e*, Parthenogonidia in successive stages of division.

Fig. 4. Complete antheridium.

Figs. 5 and 6. Antherozoids.

Fig. 7. Oosphere containing antherozoids (see also Fig. 1, *b4*).

Fig. 8. Fertilized oosphere.

All the figures highly magnified.

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*This is the course followed in McNab's recent class-book of botanical classification.

†"Annals of Natural History," Third Series, Vol. II, 1858, p. 237.

A Few Remarks on Insect Dissection.

Paper read before the Quekett Microscopical Club, Jan. 25, 1878, by T. Charters White, M. R. C. S., F. R. M. S., etc.

PERHAPS no field of microscopical research teems with richer veins of interest and instruction than that upon which I have ventured to intrude this evening, but feeling so deeply interested in it myself, I may be pardoned if, in the absence of others better qualified, I endeavor to throw out a few suggestions that will be of assistance to those amongst us, who, taking up the scattered clews of my short paper, may work them into a fabric of surpassing pleasure.

The lengthening days of early spring already invite our attention to the resurrection of animal and vegetable life, and, like good generals, preparing for a campaign, we should begin to lay our plans for future work during the coming year.

With the advent of our summer excursions many opportunities will be afforded us for leaving the busy throng, and exchanging its bustle for a few short contacts with nature in her loveliest aspects; and while many of our members will find a revival of old delights in the capture of *Conochilus* and *Volvox*, there may be others who, like myself, see in their revolutions, beautiful as they are, only the same monotonous rolling as we have ever witnessed, and would rather behold something of that wondrous evolution manifested in the development of the various forms of insect life, so abundant in the early months of the year; and which may be compared to simple experiments in biological science, ready-made to the hands of the diligent students who will take the trouble to look for them.

Of all anatomical studies, that which treats of the comparison of a particular organ in one animal, with its homologue in another, yields the most untiring pleasure to those engaged in them. The study of comparative anatomy is inexhaustible in its interest, and many amongst us would take it up but for a mistaken notion which prevails, and leads many to suppose that all studies having anatomy for their basis should, by reason of their nature, be relegated to the region of the medical theatre and the dissecting room; that none but "doctors," especially educated for such researches, are capable of mastering the difficulties of their details; but that feeling is a mistake, and the sooner it is dissipated the sooner will the clear light and joy of a new field of investigation be opened up for your delectation.

With these few words of encouragement, I will proceed to say something relative to the practical carrying out of the subject under consideration.

Three things will be found necessary, viz., magnifying power, good light and instruments, and we will treat of these in this order:

All who have seen the dissections made by our friend and fellow member, Mr. W. T. Loy, must have admired the skill and neatness with which they were done, and could only regret that he had not in many more instances carried them on to the isolation of the separate organs of each insect, for no member seems to possess greater operative delicacy than he. By his kindness I had an opportunity of inspecting a very ingenious method of adapting his magnifying power to his work, which I should like to describe to you, although I have not his permission for so doing; it struck me by its simplicity, as well as by its efficacy, and therefore I trust I may be allowed to mention it without incurring the character of revealing any private affair. It consists of a heavy metal foot, into which an upright iron rod is fixed—round this rod is coiled one end of a stout wire, the other end of the wire being bent into a ring to hold a watchmaker's eye-glass; this arrangement, by pressing the head down, focusses the lens upon the work, while both hands are at liberty, and when I tell you that all these beautiful dissections of his were accomplished by such a contrivance, it will be sufficiently recommended to your use, even if we leave out of consideration its comparative cheapness, compared with other optical arrangements.

The dissecting microscope I made for my own use some years ago is more complete than that I have just described, and would, if made by an instrument maker, be more expensive than that of Mr. Loy. It consists of a rod sliding within a tube, and made to stop at any elevation by a flat spring attached to it and pressing against the inside of the tube. The tube screws into a hole in the dissecting table, and the upper end of the rod is made small enough to be inserted into the hole in the handle of the ordinary three-glass pocket lens; by this means each of the three lenses may be used as occasion requires, and brought to bear on the subject. The lower power microscopical objectives, such as the 1 inch, 1½ inch, and 2 inch, may also be used, being supported in such an arrangement as that first described, but far better results will be attained by the use of an erecting glass in the tube of your microscope, because that affords a ready method of varying your magnifying power, and adapting it to the dimensions of the work under dissection, and rendering what would be otherwise very difficult a simple matter of steadiness of the hand.

Our next consideration must be in the direction of a good light, and this, with some dissectors, is so important that it occupies a priority over magnifying powers; but, however much we may differ from them in this point, there cannot be a doubt about this operating as a most important factor if we would get good results; and although a successful dissection may be made with a full light condensed on your work, yet better will be obtained by your light being supplemented by the magnifying power. The plan I have adopted for this is inexpensive and simple—a Florence oil flask is well cleansed and filled with water, then securely corked and waxed to prevent leakage. It is then supported longitudinally by a tube which grasps its neck, the tube itself being supported on an arm held on a heavy foot; this gives the power of adjusting the focus of its rays upon your dissection to any extent you may deem desirable, while should a fracture of your flask occur it is easily and cheaply replaced.

The morning light is better than any other, the horizontal rays falling more agreeably on your work than the vertical rays from a lamp at night, and in the morning the hand is steadier for the work. An advantage is gained sometimes in dissecting by transmitted light, especially if you can impart a blue tone to it; at other times greater advantage is attained by dissecting by reflected light, and on a black ground. As an aid, I would also recommend that your subject should be stained by carmine or logwood before dissecting.

The instruments necessary for insect dissection are not expensive, and may nearly all be prepared at home; but one essentially useful is a pair of small spring scissors. These cannot be dispensed with, nor can a firm but fine pair of forceps, for before you can reach the internal organs of an insect it is necessary to remove the external chitinous integument, and in some cases this is so hard that, in the case of the stag beetle, a pair of wire nippers will not be too strong for this purpose. The cutting instruments, the scalpels, in fact, may be formed out of needles set firmly in wooden handles. They may be of different widths and of various curves—such a needle ground flat and sharpened makes an excellent knife, while some of the needles may be blunt and slightly bent, for the purpose of holding the different parts down while they are cut, or of separating the organs from the entangling mass of tracheæ, with which they are bound to the adjacent structures.

Another useful auxiliary will be found in the fluid under which you must always carry out your dissection, by increasing the density with glycerine, and varying it, according to circumstances; it may be made to support and hold out of the way delicate structures that would be liable to injury, or impede the progress of dissection during the operation.

The other implements necessary are a small square of entomological cork, loaded by insertion in a plate of sheet lead, to which your subject may be fixed. A glass trough, about 1 inch in depth, or even less for some cases, is better than any other I have tried.

Now I do not, in this short paper, pretend to give you anything more than the *modus operandi* I have found useful to myself. I know there are others here who may have further information to impart relative to their procedure, and to those these few remarks may serve as the text for the subsequent discussion.

In preparing an insect for dissection, if you intend to examine merely the internal organs, it is better to remove all the external organs, as the legs, antennæ, etc., of course previously killing the insect with chloróform. Then the plan usually recommended is to pin the subject on the loaded cork, and place it in the trough under water. Now this plan is very well in some cases, but I prefer another, which I can recommend as being far more efficacious, and that is, while your insect is dry, drop upon the part you intend to fix it by, some melted wax and Canada balsam, the same composition that I have before recommended to be used as a cement for cells in dry mounting, only in this case you have to add a little more Canada balsam. You may then drop some more on your loaded cork, and stick your subject on it. There is an advantage about this, which the simple pinning will not afford, and that is you may dissect your subject to the last piece without dragging it off the cork, which very often occurs through the pins on the subject giving way.

Now, having fixed your subject, insert the point of your scissors between any of the abdominal segments at the junction of the tergal with the sternal surfaces, and carefully slit up the integument; repeat the process on the opposite side of the body, and then raise it by holding it with the forceps and clearing away its attachments with the needle, you will then not disturb any of the subjacent visceral organs, but will see them all *in situ*. Having noticed their relations one to the other, proceed to isolate them by clearing away all the tracheal attachments with two needles—a blunt one and a sharp one—and if done with a steady hand and a keen look out, no very great difficulty will be experienced in unraveling what before seemed a tangled labyrinth. It is sometimes a good plan, after removing the integument from the sternal surface, to place your subject in glycerine and water, and to leave it for twenty-four hours; but in this matter I would leave the matter to every man's own judgment, for sometimes I have found very good results arise from the simple dissection under plain water. We must bear in mind that we are working on tissues of great delicacy, and will do well to observe two precautions. Your instruments must be perfectly free from roughness, either arising from patches of rust or burrs left after sharpening. I have often experienced great annoyance after making a delicate dissection that has consumed perhaps a couple of hours, and have taken up a flattened needle to it, and not detected some roughened spot till it has caught some of the fine fibres of my work, and then all was a hopeless mass of entanglement. Again, in dissecting out the nervous distribution in insects, the nerves will be found very fragile, and will scarcely bear the strain put upon them in clearing them from the surrounding tissue; but the addition of a little alcohol to the fluid under which they are being dissected will harden them, and so prevent their rupture. This I have found a very useful agent in carrying out dissection; it comes in in all cases most advantageously, enabling you to isolate many organs, that without its aid would collapse and become, to coin a phrase, a mass of inextricability.

The medium I have generally found most suitable for mounting specimens of insect dissection in has been glycerine. Nothing has shown them up to greater advantage, and I should recommend that in preference to anything else, as it maintains their transparency, while other preservative fluids make them dense and discolored.

With these few remarks I must close this short paper, hoping it may induce some one to take up this subject, and not only produce pleasure in themselves, but also add to our knowledge in this interesting branch of biology.

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Prof. Abbe on the Defining and Resolving Powers of the Microscope.

We have, in a former article, given a synopsis of Prof. Abbé's views in regard to angle of aperture, and in accordance with an intimation we then expressed, we now give, from the same series of articles, the substance of his conclusions in regard to the philosophy of the defining and resolving powers of the instrument. As in the former case, we translate his own words:

"The distinction between the power of *definition* and that of *resolution*, so long recognized, receives, from the facts and proofs which have been detailed in these articles, a much larger meaning than was attributed to it before these reasons were known.

"From these facts, it results that the microscopic image (leaving out two exceptional cases of a similar character) consists of two superposed images, distinct both in origin and in character, and which may even be separated from each other and examined apart. One of these is a *negative* image, in which the different parts of an object are reproduced geometrically, by reason of an unequal emergence of the light; this unequal emergence being caused by the differences in the mass of the object, which affect in varying degrees the transmission of the incident luminous rays. This image may, for brevity's sake, be called the '*absorption image*,' because a partial absorption of the light causes the difference in quantity of the emergent rays. It is the main factor of the 'defining' power, the value of which is determined by the degree of exactness with which the direct incident light is gathered into a perfect focus; this being the condition under which this class of images is formed. It is, therefore, always the *direct* light—that which comes from the illuminating source—which *defines*, no matter what be the direction by which it reaches the objective, or, in other words, whatever may be the part of the front of the objective which receives it, whether central or marginal.

"But independently of this *absorption image*, all the parts which make up the internal structure of an object will be found to be reproduced a second time, though now as a *positive* image, because these parts appear as if they were self-luminous, by reason of the diffraction phenomena of which they are the cause. This second image, which may be called the '*diffraction image*,' consists, to speak exactly, of as many partial images as there are separate diffraction rays which enter the objective, since each of them produces a positive image, as was shown by the experiments heretofore detailed. As, however, these partial images have, separately, no value, and the details of the object are only made apparent when two or more are united, this total effect (that is to say, their fusion into one image) is what must be practically regarded as the important factor, making one proper diffraction image. But this 'diffraction image' is manifestly the significant factor in the microscope's power of 'resolution,' which means its ability to differentiate and separate. Its development, then, depends first and chiefly upon the angular aperture, as far as this alone determines, according to the laws we have enunciated, the limits of its possible efficiency. But its real and practical value depends at the same time upon the accuracy with which the partial images coincide which answer to the different rays of diffraction; for it is only by this last act that we get a visible presentation of the details which indicate the positive existence of the elements of a structure. Therefore, finally, since these isolated rays, whose focal reunion is the necessary condition of the formation of true diffraction images, occupy different points in the opening of the objective and are constantly changing position, according to the character of the object and the method of illumination, it is evident that in no case is there a possibility of a perfect fusion of the different diffraction images, and an exact superposition of the resulting and principal 'diffraction image' upon the 'absorption image,' *except when the objective is uniformly freed from all spherical aberration throughout the whole extent and surface of its opening.*"

On a Method of Mounting Whole Insects Without Pressure for the Binocular Microscope.

BY STANIFORTH GREEN.

MINUTE Hymenoptera (Ichneumonidæ, Chalcididæ, Proctotrupidæ, etc.), require little manipulation to render them fit for mounting in Canada balsam, and they are easily collected. I have captured numerous species in Ceylon by sweeping the grass with a small bag net, about 3 inches in diameter at mouth, and tapering down to a point at bottom. It should be made of fine cambric, as many of these small insects do not exceed the 1-64 of an inch in length. About a dessert-spoonful of spirit of turpentine should be placed in an ordinary wine glass, over which the net is to be drawn after a sweeping operation. While this is being done, the captured insects must be confined to the bottom of the net by gathering the net between the thumb and finger at about one inch from its bottom. When it has been drawn over the glass as far as it will go, then the thumb and finger must be removed, and the insects allowed to fall into the turpentine. They will quickly die, mostly with outspread wings and legs. Minute species should be fit for mounting after they have remained in turpentine for a few days. This treatment, however, will not succeed with more horny kinds, which, when thrown into turpentine or spirits of wine, curl themselves up in dying, and cannot afterwards be straightened out. Insects of that class should be placed alive on a piece of glass, and while walking, a thin covering glass can be let down upon them. Strong spirits of wine must be quickly introduced between the two glasses by means of a camel's hair brush. This soon kills the insect in the position of walking, and it should be kept so in spirits for at least six hours. I use the ordinary 3 × 1 inch slip and a good sized covering glass—the heavier the better. Seven or eight specimens can be so arranged on one slide, which may be placed in a saucer containing sufficient spirits of wine just to cover them. They can afterwards be transferred to turpentine to render them fit for mounting in Canada balsam.

Dipterous insects of moderate size may be treated in the following way: Catch them alive, and hold their wings between the thumb and finger. Thus secured, they should be dipped in turpentine, and held in it until quite dead. When released, they will be found with elevated wings and folded legs. Let them remain undisturbed in the turpentine for five minutes or so. Then take them out and hold them by the wings while you arrange their legs under a magnifier, using a needle or a pair of fine forceps with a light hand, as legs come easily off. Replace them in the turpentine for a few minutes, and then transfer them to a small glass test tube one-third full of turpentine. Hold the tube over a spirit lamp till the turpentine commences to boil. Then examine with a magnifier the insects in the tube. If cooked enough, tongues will be found protruding from their mouths, forced out by the action of the hot turpentine. The ovipositors of female insects are also similarly displayed. This process much hastens the preparation of insects destined to be mounted in Canada balsam, but they must not be overcooked, as with prolonged boiling they are rendered too brittle and transparent. After removal from hot turpentine, they should remain in cold turpentine until they become tolerably transparent, with a perfectly clean outline.

Spiders should not be boiled in turpentine. Kill them in spirits of wine, and then place them on a piece of glass,* and arrange their legs and antennæ in proper position, or as near as possible. Then wind a piece of fine sewing silk or thread around the glass in a way to keep the legs in the position they have been placed. When the winding has been completed, twist the ends of the thread together to keep them fast. Then place the piece of glass with the spiders on it in turpentine, and let it there remain until the spider becomes sufficiently transparent. I have sometimes first placed the bound spider in spirits of wine for a few days, and afterwards in turpentine, to render it more quickly transparent.

In my opinion the advantages gained by preparing insects in the way I have described are that they do not alter in figure, or very little so; that their muscular structure is well shown, their eyes, tongues and ovipositors nicely displayed, and preparation easy of management after a little experience.—*Journal Quekett Microscopical Club.*

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The Effect of Politeness.

A BRAVE, active, intelligent terrior, belonging to a lady friend, one day discovered a monkey belonging to an itinerant organ-grinder, seated upon the bank within the grounds, and at once made a dash for him. The monkey, who was attired in jacket and hat, awaited the onset with such undisturbed tranquility that the dog halted within a few feet of him to reconnoitre. Both animals took a long, steady stare at each other, but the dog evidently was recovering from his surprise, and about to make a spring for the intruder. At this critical juncture the monkey, who had remained perfectly quiet hitherto, raised his paw and gracefully saluted by lifting his hat. The effect was magical; the dog's head and tail dropped, and he sneaked off and entered the house, refusing to leave it till he was satisfied that his polite but mysterious guest had departed. His whole demeanor showed that he felt the monkey was something "uncanny," and not to be meddled with.—*Nature.*

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*I usually cut suitable pieces from rejected slips.

Oleomargarine.

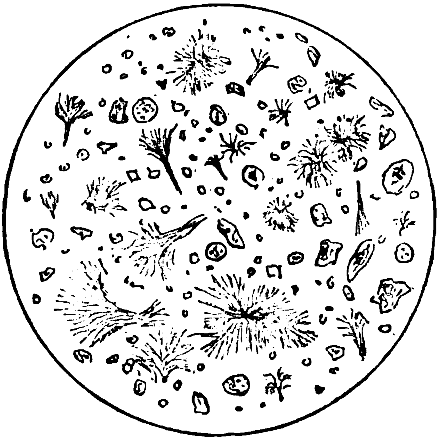
BY JOHN MICHELS.

HAVING observed paragraphs in various medical and scientific journals, stating that oleomargarine could not be distinguished by the microscope from butter, and suggesting various chemical methods to meet the difficulty, I was prompted to purchase samples of these substances and make a careful microscopical examination of them.

The oleomargarine I purchased as an ordinary customer from one of the depots of the largest manufactory in New York city, and the butter was obtained from Messrs. Park and Tilford of the same city.

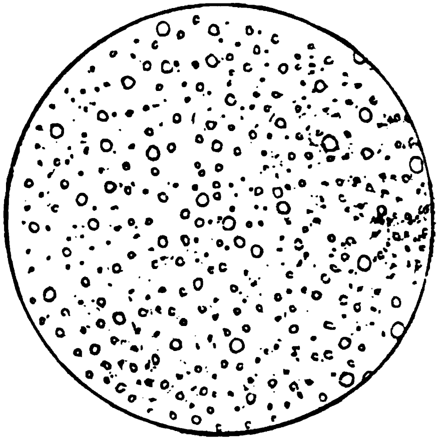
The result of my examination was very decisive and just what I expected; namely, that the oleomargarine was loaded with free stellate or feathery crystals, and that the butter presented the uniform appearance of fat globules so often described in hand books, and perfectly free from any crystalline forms except those of chloride of sodium or common salt.

I here give drawings made by the camera lucida, showing the relative appearance of these two substances, each of which is very characteristic, and should enable them to be readily distinguished at all times.



APPEARANCE OF OLEOMARGARINE UNDER THE MICROSCOPE.

I examined a large number of samples under different temperatures, and under a variety of conditions, but the results here shown, are from two samples examined just as they were purchased, pressed out to a fine film in the usual manner, under a thin cover, and examined with a four-tenth objective by Beck. During some months I always found the same results, but discovered that by a trick and by manipulating the samples, the butter could be made to show a field full of crystals, and the oleomargarine free from them; but examine true samples of either in their normal condition, and the results I have shown will always be observed.



APPEARANCE OF BUTTER UNDER THE MICROSCOPE.

As I have stated, my examination of oleomargarine extended over some months, during which period I invariably found that each sample contained cells of a very suspicious character, with fragments of tissue and muscle. This led me to investigate the process of manufacture, and I then found that during the whole process, from first to last, the animal fat, etc., of which this substance is made, is never subjected to a higher temperature than 120° Fahrenheit.

It at once occurred to me, that taking into account the well known thermal death point of certain organisms frequently found in animals, which, although diseased, are regarded by dealers as fit for food, such a temperature of 120° Fahrenheit, was totally insufficient to destroy the germs or even the adult individuals of such forms of life.

Again, the original French patent states that the stomachs of two pigs or sheep should be chopped up with a certain amount of fat, on account of the pepsine there contained, and I found that this practice was in use in the New York oleomargarine manufactories. For these reasons, I conclude that oleomargarine thus manufactured is not a safe or wholesome article of food, and I assert that, however disguised it may be in appearance, oleomargarine, as offered for sale, is nothing but *raw fat*, liquified, scented, colored and flavored to give it a spurious appearance of butter, and that those who use it run the risk of trichinæ, from the stomachs of pigs chopped up with the fat, and that infection from certain contagious diseases, which are common to man and the domestic animals, might follow.

These views were offered on general biological grounds, based on principles and established facts, with which all are familiar who have studied the subject.

The result of my work having become known, direct contradictions have been given which I will now notice. In opposition to my views, a certificate has been produced, signed by Professor J. W. S. Arnold, of the University of New York, stating that he has examined with the microscope, butter and oleomargarine, and that he finds their optical appearance alike. He presents two drawings of these substances, which are substantially similar in all respects.

I am thankful that I am not under the necessity of explaining this certificate of Dr. Arnold, but in justice to myself, I beg to state that it is false to the true facts of the case. From Professor Arnold's drawings he appears to have had two samples of dairy butter under examination, and the impartial judge of this question must remember, that Professor Arnold permitted the oleomargarine manufactory to prepare its own specimen, which was handed in by the chemist of the company, Dr. Henry Mott, who is answerable for the error of making oleomargarine at a temperature that renders it dangerous for use.

Professor Arnold could find no margarine crystals in oleomargarine, and yet it is well known that under certain circumstances, solid fat separates from the natural fatty matters of the body in the cooling of the latter after death, in the form of needle shaped crystals or groups of the same, and that these are known to microscopists as margarine crystals, and that sometimes these crystals may be seen in the centre of fatty cells.

On this point Professor Brewer, of Yale, also comes to the rescue of the oleomargarine companies, by stating "his belief" that oleomargarine cannot be distinguished from butter by the microscope, but adds, "on this I cannot speak with certainty."

It is difficult to criticize this timid expression of opinion, bearing in mind that it is not on some wild hypothesis, but a scientific report from Yale College on the physical appearance of two common substances, which may be seen distinctly in the field of the microscope.

"His belief." I would ask Professor Brewer if he ever made a microscopical examination of these substances; if he did he must know *for certain* that they are *alike* or *dissimilar*, for they cannot be both. If he has not really studied the subject, I can understand his having merely "*a belief*," and "uncertain" at that, but then why did he write a letter, and allow himself to be quoted as a high authority, for the purpose of contradicting my work, and making it appear ridiculous in a public journal?

I now come to the second point, the question of temperature. What I say is, that it is important in estimating the dietetic value of oleomargarine as a substitute for butter, to take into account that it is manufactured from the fat of animals, the stomachs of pigs and sheep, and that 120° Fahrenheit is totally insufficient to kill the embryos of parasites, or destroy the germs of disease, which exist in a very large proportion of domestic animals used for food. And that I have found portions of tissue and muscle in oleomargarine when offered for sale, and cells and forms of a suspicious character, and that others (Mr. Taylor) have positively identified germs of disease in that substance.

On this head, both Professor Verril, of Yale College, and Professor Brewer, join issue with me; the first makes the assertion that "trichinæ and worms do not appear in caul fat," as if that covered the whole ground of my statement. There can be no doubt that fat and grease of every description are used to make oleomargarine, because all the caul fat of oxen brought to New York city in a week would not be sufficient for one manufactory for four days, and there are seven oleomargarine manufactories. But surely Professor Verril has heard of trichinæ in the stomachs of pigs. And, moreover, I spoke of all the septic organisms.

Professor Brewer has been publicly advertised as charging me with "talking nonsense," when I allege that the refuse of city abbatoirs, and the stomachs of animals, merely subjected to a temperature of 120° Fahrenheit, is not fit and wholesome food to put on the breakfast table.

On this point I would ask the impartial reader to peruse a letter from the Rev. W. H. Dallinger, who has seen the same article from my pen, thus criticized by Profs. Brewer and Verril. Mr. Dallinger is certainly the greatest living authority on this subject, and I therefore present his opinion without further preface:

The Parsonage,
Woolton, Liverpool, June 21, 1878.

J. Michels, Esq.:

My Dear Sir—I have been for the past fortnight engaged in London, and some little delay has arisen in my reply to your letter, for which I am sorry. I am glad to see that you have taken up in so calm and scientific a spirit so important a matter. I have not the least hesitation in expressing my conviction that the inference you make is a correct one. A temperature of 120° F., is not by any means seriously, and certainly not permanently injurious to even the *adult* forms of the putrefactive organisms. I have recently made some very careful experiments on this matter by a new method, the results of which I have very recently laid before the Royal Society of London; and when I receive copies I will forward one to you.* You will then see that by a well and delicately prepared apparatus, I was enabled to test the destructiveness of heat *directly* on the organism, and to prove by the use of the highest powers that they could endure—as fully developed forms in full activity—temperatures up to 140° to 142° F. without permanent destruction. They were rendered inactive for awhile, but sooner or later revived, and I have strong experimental evidence leading up to the conclusion that the whole septic series of organisms require a temperature of 140° F. to kill the fully developed living forms. But besides this, we know now that the *germs* of this series of organisms require at least 212° to 235° F. for *their* destruction *in fluid:* consequently, it is no coloring of facts to say that the temperature reached in the manufacture of oleomargarine is perfectly innocuous to such organisms of this kind as the refuse fats may contain.

Quite as serious a matter is that of the introduction, through its means, into the human intestinal track of eggs of entozoa. I have made no elaborate investigations on this subject, but it cannot be forgotten that the developed organisms in this case live normally at a considerable temperature; and I have made enough experiments on this subject to say that the eggs, for example, of the *nematoda* are practically uninjured (when not in a developing condition—that is to say when freshly deposited) by 120° F. This is an important matter, and although likely to be in practice neglected at first by the public, may probably impress itself upon them in an unwelcome manner.

My opinion, as you perceive, is given on general biological grounds, and not from any special investigations in this particular case.

Our microscopical society is not now in session, but at our opening meeting I shall be glad to present your paper. I am, my dear sir,
Very truly yours,
W. H. Dallinger.

I may also state that *since my results* were first made known, the following independent confirmation was published in the *Sci-*

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*This paper was republished by us in full in the August number of this journal.

entific American, giving the result of the appearance of butter and oleomargarine under the microscope, by Mr. Thomas Taylor, Microscopist of the Department of Agriculture at Washington.

Mr. Taylor reports that when pure dairy butter is viewed under the microscope, the forms consist of oil globules and the crystals of common salt; "when a specimen of oleomargarine is examined in the same manner, the field was speckled over with shiny particles, and it was demonstrated that these glistening particles were crystals of fat." "In using a power of 250 diameters, animal tissue is seen more or less all over the field." "One specimen of oleomargarine was highly charged with animal tissue and crystals of urate of magnesia, showing the fat used in this case to have been impure, which would seem to prove that the assertion made by the oleomargarine manufacturers as to the perfect purity of the fats used by them, are not altogether correct."

"From this it would appear that oleomargarine may be easily known from butter by the aid of the microscope, and that any impurities in the fats of which it may be composed may be readily detected."

Thus my work and report on the nature of oleomargarine has been confirmed and supported by those to whom I am a stranger, except by correspondence, and who are therefore impartial. In conclusion I am forced to notice briefly a letter on this subject that appeared in the New York *Times*. It was signed by Dr. Henry Mott, and purported to be a review of my report on oleomargarine addressed to that paper.

I may remind those who read that letter, that in it I was described as "a person perfectly incompetent to make a microscopical examination;" my paper, "purposely originated to create a sensation;" "gross misrepresentations of an amateur;" my results, "manufactured, result of ignorance or *intentional misrepresentation.*" I am termed "unprincipled enough to insinuate;" I had been "hunted up by men whose avarice is paramount to principle."

Side by side with this scurrility was the certificate of Prof. Arnold, from the University of New York, and letters from Profs. Verril and Brewer, from Yale College. On my applying to the New York *Times* office, I was candidly told by the editor-in-chief, that the letter to which Dr. Mott had signed his name, was nothing but an advertisement from the oleomargarine manufactory, and that large and special rates had been paid to get it inserted in the news portion of the paper. That they had received quite a large sum of money, in fact, hundreds of dollars, and that therefore *no reply would be permitted to me.* I state these facts, and leave them without comment, for if honored names and great public institutions can thus be used to advertise a grease factory, abuse rather than praise must be welcome when emanating from such a source.

38 *University Place, New York.*

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The Microscope in Medicine.

At the present day the microscope forms an important and valuable instrument for the physician and student; and he who does not avail himself of its utility in the diagnosis and treatment of disease, especially when of an obscure or obstinate character, is greatly behind the present era of his profession. Indeed, no practitioner, who is not conversant with the revelations made by this instrument concerning the structure of the various parts of the system in health, and the changes effected upon these structures by disease, can lay claim to the title of a "respectable physician." It has often occurred that during the initial stages of severe and fatal maladies, the microscope has afforded information which, even before any appreciable symptoms had become developed, revealed to the practitioner the alarming condition towards which the patient was more or less rapidly hastening, and thereby led him to adopt an efficacious course of treatment, long before the pathological lesions had become serious or of a permanent nature. But the value of the microscope does not cease with medicine; it has proved of immense service in geology, botany, mineralogy, chemistry, and indeed in nearly every department of science, beside having proven exceedingly advantageous in the detection of adulterations in food and drugs, as well as of filth and impurities. Unfortunately some have conceived the microscope to be a mysterious instrument, capable of being managed or understood only by certain particular persons; this is a great mistake; the instrument is intended solely as an aid or improvement to our sense of sight. Objects which can be seen well by the naked eye, do not require its assistance, save for the investigation of their minute structure; but with those which are too small to be thus seen, the power of vision is greatly aided by its employment, and every individual possessed of sight can readily avail himself of such assistance. Parties with imperfect vision employ lenses or spectacles to improve this sense; and the microscope, a combination of lenses, improves the magnifying and defining powers of the eye, almost enabling it as it were, to observe and scan the invisible. Many parties possessing a microscope, instead of perfecting themselves in its use and its revelations, allow it to remain peaceably in its case, until they are suddenly aroused to demand some information from it; a satisfactory response is not obtained, and the conviction is then had that the instrument is of no service. This almost always happens with those who have not, by practice at leisure moments, made themselves capable of interrogating it by proper management—a mortifying and painful acknowledgment! And yet, no better results are obtained from the ophthalmoscope, the laryngoscope, or the aural mirror, instruments of undeniable ability, occupying definite places among our means of diagnosis, if, perchance, one has never learned their management. It does not require a person to be an eminent microscopist or an accomplished chemist, in order to be a successful diagnostician and therapeutist.

A great obstacle to the more common use of the compound achromatic microscope, heretofore, has been its expensiveness; but excellent instruments are now made by our best opticians, termed "student's microscopes," which will accomplish all that a practitioner can desire. The value and usefulness of a microscope does not lie so much in the beauty or workmanship of its brass mountings and other metallic accompaniments, as in the quality of its objectives and eye-glasses. However great may be the magnifying powers of a microscope, it is useless unless it likewise possesses penetrating and defining powers. And in the purchase of one of these instruments, the name of its manufacturer should always be learned, as our best opticians never permit poor or imperfect glasses to leave their workshops.

In selecting an instrument, the error is frequently made of purchasing a very complete and expensive one, in the hope that it may be more easy to manage, and will give superior results; but the contrary more generally happens. For if an individual does not apply himself to regular histological researches, he will soon ascertain that he has needlessly expended several hundreds of dollars, unless, indeed, his pecuniary resources are large and abundant. Movable stages, condensers, extra rack movements, diaphragm holders, etc., are absolutely useless for daily and practical observations. It is at once more economical and more convenient to purchase a simple "students' microscope," the optical apparatus of which is unobjectionable; to which may be added, from time to time, as may be desired, a micrometer eye-piece, of which we should calculate the value of each division for the series of powers possessed by the microscope, and the figures indicating such values should be arranged in tabular form on a card, which should be kept suspended near the table at which we work. This will enable us at once to determine the dimensions of any microscopic element submitted to observation.—*King's Urological Dictionary.*

The Hard Tissues of Animals—Their Origin and Formation.

Paper read by Mr. Xenos Clark before the San Francisco Microscopical Society, Sept. 19, 1878.

ANIMALS need hard tissues to support their bodies, to protect these bodies by a complete or partial encasement, and for the mastication of solid foods. Those conditions in the environment which determines these needs, are quickly found. In the first place, soft tissues are indispensable to living beings, being essential to osmose, without which assimilation is impossible, and to muscular contractility, the prerequisite to motion. But the aggregation of these soft tissues into bodies of any size would be impossible without a rigid framework to resist external strains and blows, and to maintain the various tissue-built organs in the proper relative positions against the force of gravity. Two barely less important external factors that require provison for, are the depredations of preying animals, and the hard roughness of most natural objects, both disastrous to soft tissues. When, as in the mollusca and insecta, the supporting hard tissue is external it also serves for protection against these carnivorous enemies, and against the contact of rough objects, when it forms an internal skeleton, like that of the vertebrates, a special surface-protection structure exists, as the scales or plates of fish and reptiles, the box of the turtle and armadillo, the hair, nails and feathers of other animals. Quite as obvious are the factors that demand a solidly-built masticatory apparatus; were it not so built, many hard, bulky foods could not reach the stomach, or else, reaching it, would receive the action of its digestive fluids on their external surface only.

Having found abundant reasons for the existence of hard tissues, we next inquire what are the resources of nature available for their building, and how these resources are employed. Of the proximate elements which enter into animal tissues, the organic compounds will not serve, being of too soft, colloidal, unstable a nature; there remain the inorganic compounds, or minerals. These are certainly in sufficient abundance, since the earth is composed of them; but the supply is immensely narrowed by the limitations of digestion, which require that the mineral be soluble, capable of assimilation, like food. The field thus reduced is still further restricted by another condition—that the mineral be not too soluble. Salt and the alkaline carbonates, though so abundant, are unserviceable by reason of the very quality causing that abundance, their great solubility. Any hard tissue they might form would be continually liable to resolution in the fluids of the body. The available mineral, then, must evidently be some substance soluble under temporary conditions, during whose existence it may be carried from the stomach to the place of use, and there, these conditions being removed, may remain a fixed, insoluble solid. Such minerals are the very ones revealed by chemical analysis of hard tissues to be their essential and predominant components. Thus the shells of foraminifera, mollusca, corals, crustacea and echinodermata are all chiefly composed of carbonate of lime, a compound held in solution by all waters containing free carbonic acid. The presence of carbonic acid, essential to the solution of carbonate of lime, constitutes the temporary condition above mentioned. Whether fresh or ocean waters come in contact with the tissues of aquatic animals, the free carbonic acid is removed by the alkaline carbonates of soda and potassa, always present in animal fluids, and the carbonate of lime, the conditions admitting of solution being no longer present, is deposited. Sulphate of lime, also soluble in water, on contact with the alkaline carbonates, is decomposed to form carbonate of lime, a further contribution to the growing shell, and sulphate of the alkali, which escapes. A less frequently employed substance is silica, found in shells of radiolarians, sponge spicules, and the frustules of diatoms, which, though not animals, are identical with animals as far as this investigation is concerned. The conditions of solution for silica (the presence of an alkali or alkaline carbonate, and the colloid form, which latter is soluble in water alone), are much better known than the causes of its deposition in living tissues. Hardly more can be said than that some physiological process having destroyed the conditions requisite to its solution, as in the case of lime, deposition in a permanent form ensues.

That physiological process may be a local neutralizing of the alkaline carbonate, or a decomposition of some salt of silica, or some unknown reaction.

The skeletons of vertebrates possess as their chief ingredient phosphate of lime, evidently because, not being bathed like aquatic animals in a medium containing abundance of calcium carbonate, the supply of material for hard tissue must be derived from vertebrael food, of which calcium phosphate is the most available mineral constituent. This compound, taken from the soil by plants, and directly through plants, or indirectly through animal food conveyed to the stomach, is there passed to the blood, where albuminous matters keep it in solution. In addition to this, there are phosphates of soda and potassa present in the blood, and these, with the phosphate of lime, upon reaching the proper place, are, by an action of alkaline carbonates, similar to that which deposited the carbonate of lime, built into the insoluble bone. In considering the foregoing cases, it should be remembered that the chemical reactions, instrumental to the deposition of hard tissues, are aided by physical factors; for example, the mere fact that a deposition is begun tends to concentrate further deposition in that area; and again, the favorable opportunities for osmose and dialysis offered by tissues and membranes must make those physical reactions instrumental in determining the separation, concentration, and deposition of mineral compounds.

There remains a distinct class of hard tissues, wholly unlike those so far considered in being of organic composition. The insects and crustacea possess these almost exclusively (the crustacean test is also sub calcareous); amongst other animals only minor protective or prehensile parts—the nails, hair, bill, feathers, horns, hoofs and callosities—fall within the class. The integument of insects is hardened by a deposition of chitine, and usually forms a rigid exoskeleton to which the muscles are attached. Nails, horns, hair, etc., are composed of closely packed fibrous or tabular epithelial cells, thrown off by a special infolding of the skin, which, by means of its plicated surface, supplies the hardened epithelial cells in sufficient abundance to thrust their cemented mass beyond the general surface in the shape of a horn, a claw, a hair, etc.

As to the causes which have given hard tissues their various peculiar forms, since much is known for the higher animals and very little for the lower, it will be best to descend the animal scale, passing from the better known to the less known.

The action of organic processes, in answer to the demands of the environment, probably almost wholly determine the microscopic or bulk form of all hard tissues above the protozoa. This field is already well covered by "Spencer's Biology" (Morphological Development). The microscopic form of these tissues has also been investiga'ed by George Rainey, who published, twenty years ago, a work on "The Mode of Formation of Shells of Animals, and of Bone, by a Process of Molecular Coalescence." He found that by allowing phosphate and carbonate of lime to solidify in a solution of gum or any other colloidal substance, globular concretions exactly similar to urinary calculi and to the microscopic structure of bones and shells result. This remarkable discovery at once proved the internal form of many hard tissues to be wholly due to physical causes—the deposition of mineral salts in a viscid liquid. Whether Rainey's attributing of all the *minutiæ* of bone histology—*lacunæ*, canals and *canaliculæ*—to these physical causes be true or not, they undoubtedly play a prominent part in determining those *minutiæ*, and the detailed structure of shells is almost wholly due to their action. The thin laminæ making up any molluscous shell are formed by the growth of variously-shaped concretions in a surface membrane bathed alike by the lime-charged waters of the ocean and alkaline fluids of the animal.

Where the hard tissues occur in animals of any physiological complexity, as the vertebrates, echinoderms, mollusca, worms and corals, this discovery of Rainey, with such local factors as the functions of the animal may reveal, sufficiently account for the structure of those tissues; but when we consider beings of almost no physiological complexity, the marvellous regularity and elaborateness of their markings and form are incomprehensible. I refer, of course, to the foraminifera, radiolaria (more commonly known as polycistina), and diatomacea. It is only possible to indicate the path to a solution of this interesting problem, pointed out by what is known of the deposition of similar tissues amongst higher forms.

The experiments of Rainey showed conclusively that any gummy, viscid substance, in other words a colloid, profoundly modifies the form of a mineral substance that may solidify from solution in it. Noting that, as the soft tissues are all such colloids, minerals are always solidified in living forms under these modifying influences, we may next pass to crystallography for an instructive fact. When in certain crystals any foreign substance becomes entangled during the formation process, that substance tends to take beautifully symmetrical forms, quite unlike any shape it may assume when alone. These facts, taken together, seem to prove physical processes capable of at least contributing to the peculiar shapes of diatoms, polycistina, etc., whilst the structural and functional simplicity of these forms would even seem to place the whole burden of explanation upon physical causes. Indeed, Schultz, by solidifying silica from solution in a viscid liquid, obtained forms very suggestive of diatom markings, forms sculptured in the same way, but without the geometrical regularity of diatoms.

It may be noted as pertinent here that the cocoliths found by Huxley scattered through Bathybius are very suggestive of Rainey's artificial concretions, and Bathybius, whether protoplasm or colloidal sulphate of lime, is a viscid nidus, favoring the disposition of such concretions. There should be added here, too, for explanation, the double wheel amphidiscs of sponge gemmules, and the sometimes elaborately-shaped sponge spicules. It is interesting, also, to note, as bearing on some explanations here advanced, the extreme abundance of limestones deposited in the Carboniferous Age. At that time the air and water were surcharged with carbonic acid, a fact leading probably to the solution of a greater amount of calcium carbonate, the larger use of that substance by aquatic animals, and the consequent profusion of their shelly remains, which constitute the limestones. An analogous phenomenon is to be observed in the more profuse shell growth of the land snails in alkaline regions, as our great deserts, a matter quite comprehensible when the effective part played by alkaline compounds in the deposition of shell tissues is remembered. In fact, the progress of biology is a continued revelation of the dependence of life upon physical conditions, a dependence not transitory or local, but permanent and general, a dependence like that of the potter's vessels upon the nature of their future contents and purposes, which determine whether they shall be conical or globular, perforate or solid, glazed or porous.

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—The Parisian International Congress on Weights, Measures, and Coins, at Paris, "learns with pleasure the progress of the metric system, and deplores the fact that England, Russia and the United States have not yet entered into the same path." The British and American members had a meeting, and voted to petition their Governments in favor of the system.

To Remove Tight Stoppers.

To remove glass stoppers when tightly fixed, it has been recommended to apply a cloth wet in hot water. This is an inconvenient and frequently unsuccessful method. The great object is to expand the neck of the bottle so as to loosen it on the stopper. If, however, the latter be heated and expanded equally with the former, the desired effect is not produced; and this is often the case in applying hot water. By holding the neck of the bottle about half an inch above the flame of a lamp or candle, for a few seconds, we have never failed in the most obstinate cases. The hands should be wrapped in a towel, and great care should be taken not to let the flame touch the glass, as this might cause it to crack. The bottle should be kept rapidly turning during the operation, so as to bring all parts of the neck equally under the influence of the heat, when it will be rapidly expanded, and the stopper may be withdrawn by a steady pull and twist. Following this plan, we have never failed once out of hundreds of attempts. When the bottle contains alcohol, benzine, ether, or similar inflammable liquids, great care must be taken lest the stopper should come out suddenly, and the contents of the bottle take fire.—*Amateur's Handbook.*

Glass Working.

Glass is usually brought into shape by being moulded or blown. There are a few other operations, however, which are constantly needed by the amateur, and which we will describe.

For cutting flat glass, such as window panes, and for cutting rounds or ovals out of flat glass, the diamond is the best tool; and, if the operator has no diamond it will always pay to carry the job to a glazier rather than waste time and make a poor job by other and inferior means. When, however, it is required to cut off a very little from a circle or oval, the diamond is not available, except in very skilful hands. In this case a pair of pliers softened by heating, or very dull scissors, is the best tool, and the cutting is best performed under water. A little practice will enable the operator to shape a small round or oval with great rapidity, ease and precision. When bottles or flasks are to be cut, the diamond is still the best tool in skilful hands; but ordinary operators will succeed best with pastilles, or a red hot poker with a pointed end. We prefer the latter, as being the most easily obtained and the most efficient; and we have never found any difficulty in cutting off broken flasks so as to make dishes, or to carry a cut spirally round a long bottle so to cut it into the form of a cork-screw. And, by the way, when so cut, glass exhibits considerable elasticity, and the spiral may be elongated like a ringlet. The process is very simple. The line of the cut should be marked by chalk, or by pasting a thin strip of paper alongside of it; then make a file mark to commence the cut; apply the hot iron and a crack will start; and this crack will follow the iron wherever we choose to lead it. In this way jars are easily made out of old bottles, and broken vessels of different kinds may be cut up into new forms. Flat glass may also be cut into the most intricate and elegant forms. The red hot iron is far superior to strings wet with turpentine, friction, etc.

For drilling holes in glass, a common steel drill, well made and well tempered, is the best tool. The steel should be forged at a low temperature, so as to be sure not to burn it, and then tempered as hard as possible in a bath of salt water that has been well boiled. Such a drill will go through glass very rapidly if kept well moistened with turpentine in which some camphor has been dissolved. Dilute sulphuric acid is equally good, if not better. It is stated, that at Berlin, glass castings for pump barrels, etc., are drilled, planed and bored, like iron ones, and in the same lathes and machines, by the aid of sulphuric acid. A little practice with these different plans will enable the operator to cut and work glass as easily as brass or iron.

Black diamonds are now so easily procured, that they are the best tools for turning, planing or boring glass where much work is to be done. With a good diamond a skilful worker can turn a lens out of a piece of flat glass in a few seconds, so that it will be very near the right shape.—*Amateur's Handbook.*

— The great Swedish University of Upsala has a vacant professorship of anatomy which it cannot get anybody to fill, because there are no foreign savants in this department who understand the language. In former centuries no such difficulty was encountered, since university lectures were everywhere delivered in Latin, which the learned of all nations understood.

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TOWARDS the close of last year, we asked our subscribers to state whether they preferred trimmed or untrimmed copies of the journal. The answer came overwhelmingly, "Cut!" About the time that the first number was to be issued, however, we were led to hope that all difficulty in this direction would be avoided by the adoption of new machinery which perforated the edges instead of trimming them. Unfortunately that machinery has not proved successful, and we again find ourselves confronted by the old difficulty. As our desire to give as much matter as possible in each number has led us to make our pages very large, the margin is small, and many of our subscribers prefer to have their copies untrimmed. We intend hereafter to keep two lists of subscribers, one for trimmed and the other for untrimmed copies. Our subscribers will therefore have the goodness to inform us on which list they wish to be placed. The keeping of two lists involves considerably more trouble than the keeping of one, but we are anxious that those who desire it shall have copies with large margins for binding. Where no directions are given the journal will be sent trimmed. We cannot undertake to exchange trimmed for untrimmed copies after they are once sent out.

Instruction in Microscopy.

IT is an old saying, "C'est le premier pas qui coute,"—which may be freely translated to mean that the first step is always the most difficult. This is true in business and study, and nowhere more so than in microscopy. After the beginner has learned a few elementary methods and manipulations, it is not difficult for him to get along himself. The difficulty has hitherto been that most of those who have a liking for microscopy have had no opportunity to get the first start. Mr. D. Bryce Scott, the curator of the New York Microscopical Society, has undertaken to supply this want, and those who desire to learn the practical use of the microscope are invited to meet him at the rooms of the society, 1,267 Broadway, on Monday and Wednesday evenings. Mr. Scott is well known as one of our most skilful manipulators, so far as the preparing and mounting of objects are concerned, and the opportunity thus offered is one which does not often present itself. The instruction is free.

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New Rooms of the New York Microscopical Society.

THE New York Microscopical Society is to be congratulated on the fact that it has taken possession of its new rooms, which present a most cosey and home-like appearance. The furniture is plain, but convenient, and the members hope to have many a pleasant and profitable evening in it. Citizens of New York who may not be members of the society, but who take an interest in microscopy, will always be welcome as visitors, and we hope to see the society increase rapidly in its membership. Societies are like fires; a few sticks burn feebly and slowly, while a large number make a hot and pleasant fire.

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Deposits from Water of the Mississippi River.

MICROSCOPISTS who desire a specimen of the crude material of the precipitate of the Mississippi river water, as furnished the city of St. Louis, drawn from a hydrant July 11, 1878, can secure a specimen for a stamp. None but microscopists of note need apply, and those who are subscribers to the AMERICAN JOURNAL OF MICROSCOPY. One United States standard gallon contained 420 grains of dried matter. 17.5 grains of sulphate of alumina was the reagent used; this amount is not deducted from the precipitate. This is the greatest amount of dried matter found in one gallon of hydrant water in St. Louis for over two years. Address J. Siler, 1,242 Broadway, St. Louis, Mo.

The Proposed Micro-Metric Unit.

AT the recent meeting of the Microscopical Congress at Indianapolis, Prof. R. Hitchcock offered the following resolutions in regard to a standard for micrometric measurements:

Resolved, That this Congress, representing the various microscopical societies and microscopists of the country, recommend and adopt, for universal use, from this time forth, the 1-100th of a millimetre as our unit of micrometry.

Resolved, That we request each society of microscopists to formally approve our action in this matter, and to request that all authors of papers conform to these resolutions whenever practicable, and that they communicate whatever action they may take to the New York Microscopical Society.

Resolved, That we request microscopical organizations of all countries to formally adopt this same unit, and communicate their action to the same body.

Resolved, That we recommend the plan of Prof. W. A. Rogers for deciding upon a micrometric standard of division to the favorable consideration of the societies.

These resolutions were adopted, and at a recent meeting, the New York Microscopical Society resolved to approve of the first one. After some discussion, the others were laid on the table. For the benefit of those of our readers who are not profoundly versed in the subject, it may be well to devote some space to a consideration of the questions involved.

The object of a general standard is very obvious. It is simply to facilitate the comparison of observations made by workers who are separated by time or space, and so long as this object is attained, the absolute character of the standard used is of very little consequence. In other words: So long as the same standard is used by a worker in France and in America, it matters very little, so far as they two are concerned, whether the inch or the millimetre is employed. If, however, one uses the inch and the other the millimetre, considerable trouble will be incurred in finding the equivalent values of inches in millimetres, or millimetres in inches, but the trouble involved in this process may not be as great as the trouble that would be incurred by any observer who was already provided with good standards, and who concluded to make a change.

The relative values of these two standards has been ascertained with extraordinary accuracy by Captain Clarke, under the direction of the British Government, and are as follows:

1 inch = 25.39977 millimetres.
1 millimetre = 0.03937043 inch.

Few of our readers probably have an idea of the delicacy of such correspondences, but a somewhat faint conception of the refinement of these measurements and calculations may be formed from the following statement:

The lines on the *Amphipleura pellucida*, the famous No. 20 of Möller's "Probe Platte," are, according to Prof. Morley, at the rate of 92,000 to the inch, and to see lines placed so close together requires a very good microscope. But if we were to express the size of an object of about one inch in length, with the same accuracy that we have just expressed the length of the millimetre in inches, the possible error would not exceed the four-hundredth part of the distance at which the lines on the *Amphipleura* are placed apart! It is, therefore, very obvious that our power of reducing one standard to the other by calculation greatly exceeds the delicacy with which we can make observations. Prof. Rogers places the limit of the latter at the one-300,000th of an inch.

Reducing the resolutions and preambles adopted at the Indianapolis Congress to their simplest forms, they will be found to embody the following propositions:

First—That all microscopists should be urged to use the so-called metric standard in preference to the inch and its subdivisions.

Second—That instead of using the metre or millimetre as a unit, a new unit be adopted, viz., the 1-100th of a millimetre.

Third—That a micrometer, prepared by Prof. W. B. Rogers, and placed in the custody of the New York Microscopical Society, be declared to be the standard with which all micrometers used in this country should be compared.

It will be well for the microscopical societies, and also for the microscopists of the country, to examine these propositions carefully before giving them their approval.

That the metric system will ultimately be the one universally used, there can be no doubt; and those who are about to provide themselves with an entirely new set of standards, would do well to adopt for general work the metre or one of its subdivisions. But, as we have seen, our power to reduce inches to millimetres by calculation greatly exceeds in delicacy our power to make observations; and where any observer has already employed the inch, or is provided with standards which he has carefully examined and compared, it becomes a serious question whether or not he should make a change. For ourselves, we should certainly not make a change of standard in any series of observations already begun.

In this connection it may be well also to give another caution: Always give the *original* observations, and if any calculated reductions are desired, give them in addition, and in parenthesis. Then if, even after the lapse of many years, it should become necessary to inquire into the accuracy of the standard employed, the original micrometer may be brought forward, and not only the instrument itself, but the actual observations may be scrutinized without any possibility of error due to mistakes in calculation or want of accuracy in reduction.

It may be well, however, for the reader to bear in mind that it is not more than once in a hundred times that micrometric measurements are stated in *absolute* quantities, that is, in terms of the inch or metre. In most cases the micrometer is used merely to ascertain the extent to which the object is magnified, and this is generally effected by placing a micrometer on the stage, and making a drawing of its divisions under the same power that the object itself is drawn. The drawing of the enlarged image of the micrometer then becomes a scale for measurement, its absolute value being determined by applying to it an ordinary rule or measure. For this purpose the particular standard that is used is of no consequence whatever, but so long as foot rules and scales divided into inches are more common than rules divided into millimetres, just so long will micrometers expressing divisions of the inch be more generally convenient than micrometers divided after the metric system. The measurements of blood corpuscles are perhaps the only absolute measurements generally made, and in the literature of this subject (at least, that in the English language, which, by the way, is the best literature relating to it) the divisions of the inch are always used. Those, therefore, who propose to investigate this subject, will save themselves much useless labor by employing a micrometer having divisions of the inch.

The first proposition may therefore be dismissed as one having little power either for good or ill. As the metric system comes into use generally, so it will come into use amongst microscopists, and not till then. Every scientific man will, of course, hail its adoption with pleasure.

The second proposition, however, is one of a much more mischievous tendency. It puzzles us to see to what possible advantage it can give rise, or why it should have been brought forward at this day, after having been proposed by Harting years ago, and justly consigned to oblivion by all intelligent workers. The principal reasons for and against the adoption of a 1-100th of a millimetre as a so-called unit are as follows:

In favor of it, we have the avoidance of fractions, of which the following may be taken as an illustration: The 1-100th of a millimetre is about the 1-2500th of an inch; instead, therefore, of speaking of the 1-833rd of an inch we might use the term, "three units," which at first seems more simple and easy of expression. In fact, however, it is not so. A "quarter of a yard" is an expression quite as easily comprehended as "nine inches." And, unfortunately, if this be the object, the unit is far too large. Harting saw this difficulty a quarter of a century ago, and sought to avoid it by making his unit the 1-1000th of a millimetre, which is the one-tenth of Prof. Hitchcock's proposed unit. This unit Harting proposed to call the *micro-millimetre*, and to designate it, the letters *mmm.* were employed. Thus we had *m.* for the metre; *mm.* for the millimetre and *mmm.* for the micromillimetre. But even Harting's unit was too large, and why Prof. Hitchcock should have gone back half a century, and suggested a centi-millimetre, passes our comprehension.

Such a proposition is, however, open to the fatal objection that it introduces a new term which must be unintelligible to all except microscopists. For example, an engineer finds a paper in which he is interested, and in which the quantities are given in the new unit; how is he to avoid the most serious mistakes unless each paper, no matter what its subject may be, shall first give a full explanation of the measures used? The truth is that this proposition of Prof. Hitchcock's tends to separate microscopists from all other scientific men, by establishing new and unnecessary units, notations and terms. And the absurdity of such a suggestion is at once obvious, when we reflect that all this fuss is made merely about the placing of a decimal point—for that is really all that it amounts to. The metre and millimetre are well known and universally recognized units, having familiar contracted designations—*m.* and *mm.* To urge the adoption of a new unit is as much a backward step as it would be to attempt to revive the old wine and beer measures, and bring them into use for special liquids.

The third proposition, which looks to the adoption of a micrometer constructed by some particular maker as a standard, is, to say the least, a singular one. It is a fact, unknown perhaps to Prof. Hitchcock, but pretty generally understood by others, that there are several very skilful artists in this country who are at present devoting their attention to the construction of accurate micrometers. Zentmayer, Gundlach, Eichorn, and others are, to our personal knowledge, working in this direction. For any scientific society to urge the adoption of the micrometers of any *one* of these makers, without first instituting a general competitive examination, would be enough to bring it into contempt; and yet this is what Prof. Hitchcock proposes that the New York Microscopical Society shall do ! ! As soon as this proposition was stated in our hearing before the society, we suggested that the society should at least appoint a committee to compare the proposed standard micrometer with the authorized standard at Washington, as otherwise the certificate of the society would be not only worthless but misleading. The reply to this was that such a proceeding was not only unnecessary, but that there was probably no member of the New York Microscopical Society who was competent to make such an investigation. If the latter statement be accepted as correct, the question naturally arises—Of what value is the certificate of such a society? We must confess that the statement seems to us a somewhat unwarranted one, especially in view of the fact that the New York Society includes in its membership two able engineers—F. Collingwood, of the engineer corps of the East River Bridge, who has given a great deal of attention to these subjects, and Charles H. Haswell, the author of a well known work which deals largely with kindred questions, and a man who has carried out with credit several original investigations of a similar nature.

The late Congress of Microscopists is now dead, and any resolutions which it may have passed are beyond recall, but we sincerely hope that the New York Society will not stultify itself by hasty action in this matter, and we trust that at its first meeting the American Society of Microscopists, which is the legitimate successor of the Congress, will hasten to absolve themselves from any obligations to which they may seem to have been committed by the inconsiderate action of their predecessors.

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Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Oiling the Microscope.

Ed. Am. Jour. Microscopy—I fear that Mr. Allen Y. Moore's advice to "well oil the working parts" of a microscope, if followed by many workers, will cause them a great deal of annoyance and trouble. I have seen many instruments badly used up by the free application of coarse oils.

The workmanship of every microscope *ought* to be so good that it will bear ten years' use without the application of any lubricator. Mine is so made, not so all. If any lubricator is used, it should be the finest "watch oil," applied not freely, but in small quantity, and then carefully cleaned off—all that is visible. For the rack, very pure thick grease, like beef marrow, in minute quantity, is preferable to fluid oils, which oxidize and become gummy.

C. S.

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TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Trausactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Sept. 19, President Hyde in the chair.

Valuable donations from Messrs. H. G. Hanks, S. Heydenfeldt, Jr., and Father Bleasdale, were announced, and the library, enriched beyond the usual periodical literature, received a splendid series of plates and text upon the "Edible and Poisonous Fungi of Sweden." The Rev. J. J. Bleasdale, F. R. S., was elected a corresponding member of the Society. After selecting a topic for the next meeting, "The Microscope as an Instrument of Diagnosis," the exercises of the evening were closed with a paper by Mr. Xenos Clark, on the "Hard Tissues of Animals—Their Origin and Formation." An extended extract from this paper will be found in another column.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Slides of moss peristome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 852, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, Cincinnati, O.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and Carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

For exchange, for a microscope, a small engine lathe (screw cutting) in nice order, costing $110. Address Dr. J. H. Converse, West Troy, N. Y.

Sections of manzanita, Calif. laurel, chapparal, Yerba lanta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

Publisher's Department.

Arranged Diatoms.—The art of arranging diatoms, either in symmetrical groups or for the careful study of certain selected specimens, has been very successfully taken up by several American microscopists. We have just received from Mr. Riner, of Greene, Iowa, a slide of arranged diatoms representing a vase of fruit. The vase is outlined by *Pleurosigmas*, and the fruit is represented by different varieties of circular diatoms, some of them showing color. Viewed with the paraboloid it is a beautiful object, and would form an interesting addition to any cabinet.

A Good Hint for Photographers.—Dr. Thos. Buzzard, who was recently undergoing the usual ordeal in a photographer's gallery, conceived the idea of suggesting some arrangement for relieving the eyes during the time it was necessary to keep them fixed upon a given object. In his own case he found that staring at a certain spot caused his vision to become indistinct, and surrounding objects became lost, as in a thickening mist, whilst as the sitting was prolonged, a feeling of giddiness and even faintness was experienced. The plan he suggested was to draw upon a piece of card, about four inches in diameter, a clock-face, and add the usual Roman figures. This card was fixed about eight feet distant, and when the sitting began he fixed his eyes upon the figure XII, and then upon the I, II, III, and so on all around the clock, shifting his gaze leisurely from one figure to the other. The result was the sitting ended without any sense of strain, and he seemed to have sat without an effort, while the slight change in the direction of vision required did not at all affect the accuracy of the portrait.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. III. NEW YORK, NOVEMBER, 1878. No. 11.

The Germ Theory of Disease, and its Present Bearing upon Public and Personal Hygiene.

A lecture delivered before the Philadelphia Social Science Association, Oct. 17, 1878, by Jos. G. Richardson, M. D., Professor of Hygiene and Demonstrator of Histology in the University of Pennsylvania.

THE devastating epidemic of yellow fever now raging in some of our Southern States has called forth so much discussion in regard to the nature of this and kindred maladies, that few persons of culture have failed to hear more or less in the last six months of the germ theory of disease.

This hypothesis, of which for more than ten years I have been an earnest advocate, notwithstanding its unpopularity both within and outside the medical profession, has, in consequence of some recent discoveries, begun to be received into favor by many physicians, although many more still look upon it with distrust, if not with contempt.

Hence, without attempting to convert you all to a faith in the absolute truth of its tenets, I believe the time has now come for me to point out exactly what its doctrines are, to enumerate the chief facts which form their support, and to indicate the precautions which, if we admit it is probably true, wisdom enjoins upon us towards preventing the propagation and spread of disease.

In order to render myself clearly understood, I will begin by explaining, in the first place, that the germ theory of disease, which was originally propounded by the celebrated Linnæus, the father of botany, more than a century ago, but has since been somewhat modified by its successive advocates, professes to account for the phenomena of small pox, yellow fever, typhoid fever, relapsing fever, measles, scarlatina, diphtheria, chicken pox, erysipelas, etc., by attributing them to the more or less mechanical irritation and other disturbances set up by masses of spores and mycelial threads developing in the blood and in the affected tissues. The period of incubation or hatching out (by which is meant the time between exposure to small pox, for example, and the development of the complaint) is supposed to correspond with that required for the germination of these spores or seeds of the fungi. The gradual increment of the symptoms is attributed to the growth of the millions of minute fungoid plants, whose period of greatest luxuriance marks the acme of the attack, and the death and destruction of which correspond to the decline of the disease.

The contagiousness of the communicable maladies is accounted for very beautifully by the existence of the immense number of spores (the true seeds of disease) constantly produced in, evolved from the affected individual, and carried through the air of a room or house, either alone or attached to some of the innumerable epithelial cells which are constantly being rubbed off by millions from the surface of our bodies.

The general absence of second attacks is admirably explained by the hypothesis that the parasitic fungus on the first occasion has exhausted all, or nearly all, of some peculiar (unknown) organic ingredient in our bodies, which is absolutely requisite for its support, according to the very same law that will, as every farmer knows, cause his wheat to fail if he plants it repeatedly in the same ground, and neglects to secure a due rotation of crops.

At the outset of my plea in favor of this doctrine, let me say that, in spite of the bold assertions of certain enthusiasts and savans with whom zeal outruns knowledge, no really skilful microscopist will at present maintain that minute vegetable organisms found in connection with contagious maladies are as yet proved to have any definite relation to them as causes of disease.

Nevertheless, the presumption that such casual relation does exist is, in my opinion, so strong that I intend to ask you to accept (as far as is readily feasible) my judgment that it will be proved in the near future, and I therefore seek in this brief address to popularize the conception that contagious diseases are conveyed from one person to another by the transplanting of microscopically visible spores or seeds, which have a separate vitality of their own, each after its kind, and which are to be escaped just as we would escape hordes of animals or swarms of insect pests, by shutting them out or killing them off, before they can succeed in fastening upon our bodies.

All true philanthropists must, it seems to me, desire that humanity should benefit by this knowledge, even at the present hour, although the conservative opponents to the germ theory, whilst evidently wavering in their defence, are not yet driven into the last ditch on this side of complete surrender.

I believe, as I wrote some years since in regard to favus, a parasitic skin disease of children, "we see to-day the same old battle fought (in regard to this skin disease, and also to small pox, diphtheria, and their cogeners) which fifty years ago was so strenuously contested by Biett and Morgagni on the one hand, and the microscopists on the other, in relation to scabies or the itch, at present universally admitted to be due to a minute insect, the acarus scabiei; and to the student of human nature it is a most interesting confirmation of the wise king's dictum, 'there is no new thing under the sun,' to observe how the same doubts, followed by the same objections, were urged against the parasitic character of the itch that are now put forward in opposition to the vegetable nature of the cause of ringworm or favus. Thus, Biett, Cazenave, Lugol, etc., denied then, that even with the aid of microscopes of high power, any insect whatever could be discovered. When, by a succession of lucky accidents, so many observers blundered into seeing the insect, that this position was no longer tenable, opponents to the parasitic theory changed their base of operations, and, admitting the occasional existence of the acarus, stoutly maintained that, instead of being the cause of scabies, it was a secretory product of that affection, and by no means a constant one. Finally, when proof that the whole disease could arise from the deposit of a single itch insect upon the skin of a previously healthy person became incontestable, the anti-microscopist took refuge in the assertion that in such cases 'the insect taken from the scabious vesicle, *being charged with the virus, the fluid of the vesicle*, by penetration of the cuticle, inserted this virus, and produced the disease,' as the innoculation of cow-pox is accomplished."

One of the strongest arguments against the doctrine that living germs can enter into the human organism from the alimentary canal, is that derived from the *a priori* probability that the solvent action of the gastric and intestinal juices must destroy all vitality in the microscopic organisms which, on this hypothesis, constituted the morbific matter, the contagium vivum of disease. A fundamental step towards establishing the germ theory, therefore, was manifestly by proving that bacteria or analogous low forms of life could penetrate from the stomach to the blood, to be thereby carried into all parts of the system, and this I was, I believe, the first to demonstrate. My observations were detailed in the *American Journal of the Medical Sciences*, for July, 1868, from which I extract the following as the most important:

"*Experiment 4th.*—At 7:45 P. M., May 17, 1868, I drank four fluid ounces of water similar to that employed in the preceding investigations, and containing multitudes of bacteria, estimated as numbering 27,000,000,000. At a quarter past eight I examined a drop of blood drawn with the aid of a cataract needle from the tip of my finger, and confined between a slide and cover cleaned with strong hydrochloric acid. Under the field of the 1·25th inch objective, the interspaces between the rows of blood-corpuscles were found to contain multitudes of apparently spherical molecules in rapid and erratic motion, but so very minute as to readily escape notice, even with this high power, except under the closest scrutiny; in the course of half an hour not less than one hundred were observed. At 9 P. M. another drop of blood, examined with the same precaution exhibited, in addition to these minute particles, other bodies less active in their movements, of much greater magnitude, and which, under an amplification of 1,100 diameters, appeared precisely similar to the bacteria I had been studying a few hours before in the identical decomposing beef juice imbibed. Five of them were thus enlarged, so as to exhibit an unmistakable organized structure totally different from their associated aggregations of Beale's germinal matter. Three of these bacteria were each about 1-12000 of an inch in length, and 1-25000 of an inch in width, very distinctly constricted in the middle; a fourth was obviously composed of four, and a fifth of six joints, arranged in a straight line, the motion of which was of that peculiar waving character so universal among the oscillatoriaceæ. The last two were most clearly visible, when they happened to lie vertically to the surface of the glass, and would probably escape observation under the 1·8th inch except in that position, or be therefore mistaken for simple globular bodies, although in several cases I detected in the second and third experiments (with a lower power) a shadowy elongation of one diameter of the revolving molecule thus observed."

These results of mine were corroborated soon after by the researches of Dr. Neftel, of New York, upon some of the inferior animals, in regard to which he informs us (*New York Medical Record*, July 15, 1868, p. 226): "My experiments so far lead me to the conclusion that the lower vegetable organisms can continue to live and multiply in the tissues of living animals, and that they can enter into the general circulation either through the intestinal canal or respiratory organs, or by means of hypodermic injections. What is their ultimate fate in the animal organism, and what their importance in producing disease, further investigation will have to show."

M. E. Semmer, in Virchow's Archives, April, 1870, in his paper on the "Results of Injection of Fungous Spores and Fungous Cells into the Blood of Animals," gives additional corroboration of the conclusions to which I arrived by personal experiment.

Notwithstanding these and other investigations, the germ theory of disease made but little real progress, at least in English-speaking countries, until about three years since, when the researches of Prof. Burdon Sanderson and E. Klein, of London, as set forth in Mr. Simon's Report for 1874, as

Medical Officer of the British Privy Council, commanded much professional attention, and doubtless led many who had previously ignored the theory to examine anew its claims to credibility.

In this report are endorsed the next two great steps towards the establishment of the germ theory, namely, the experiments of Oertel and Wassiloff, who showed that if the cornea of a rabbit is lightly pricked with a needle that has been thrust through diphtheritic false membrane, the wound does not heal up as similar tiny punctures with clean needles do, but becomes in a few days the centre of radiating streaks of brownish opacity, which, under the microscope, are seen to be made up of colonies of the vegetable spores (micrococci) of diphtheritic disease. The other important step was the detection by Obermeier, of Berlin, of a minute fungoid growth (spirillium) in the blood of patients suffering with relapsing fever, a fact which Prof. Stricker, of Vienna, whose world-wide fame as a most skilful microscopist, renders his testimony conclusive, told me only a few weeks ago he had fully confirmed.

These and other researches led Dr. William Roberts, of Manchester, England, in his annual address before the British Medical Association last year, to assert that the germ theory of disease "is now established upon a firm experimental basis, and if fairly grasped in capable hands, will very soon give us most important aid in our struggle with disease." And a recent eminent German writer on pathology, Prof. Orth, late of Berlin, now of Gottingen, declares: "Of all the modifications which the blood undergoes, the least understood, and at the same time the most important, is unquestionably that which is due to the admixture with low organisms. Recent researches leave no doubt whatever that in some diseases the blood contains during life, though to a far higher degree after death, certain low forms of animal or vegetable life. Those organisms which have a thoroughly characteristic appearance can be detected without any great difficulty with very high powers, provided the layer of blood which is examined be very thin, or that the red corpuscles have been destroyed with acetic acid or alkalies."*

The latest, and perhaps most important advance towards actual proof of the germ theory, has just been made by my friend, Prof. E. Klein, F. R. S., of London, who, in a series of admirable investigations, partly communicated to the Royal Society in Feb., 1878, shows that a kind of bacterium found in the peritoneal exudation of pigs affected with a disease sometimes called typhoid fever (but more properly entitled pneumo-enteritis contagiosa), may be cultivated in different fluids outside the animal's body for eight consecutive generations, and then produce the original malady in healthy animals upon which it is innoculated.

The daily success of Lister's antiseptic method of dressing wounds, now firmly established in the London, and many of the Continental hospitals, is a further and almost unanswerable evidence of the infective power of germs, and the wonderfully lucid explanations and ingenious experiments of Prof. Tyndall have done much to enable all to realize the intimate relation which exists between dust (which consists largely of germs) and disease.

It may not be amiss, before leaving this part of my subject, to reply to an objection which has been frequently offered to observations upon bacteria met with in connection with various diseases, namely, that such organisms, apparently quite identical, are often detected in absolutely healthy animals, and therefore cannot be causes of disease. Those who urge this argument, however, seem to forget that since the bacterial spores and rods are only the analogues of the seeds and roots of larger plants, and by no means entire organisms, it is, therefore, no more reasonable to expect us to distinguish the bacterium which develops into the cause of yellow fever, for instance, from that which produces simple putrefaction, than it is to demand we should discriminate at sight the root and seed of a choke pear from those of a Seckel. In either case it may be only by cultivating the plant to its full perfection, and testing its ripe fruit that we can determine its place in nature.

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*Dr. Orth describes the gray coating on wounds affected with hospital gangrene, and lining the uterus in puerperal fever, as being made up chiefly of micrococci and bacteria. He also asserts what I long ago believed and taught, that in metastatic abscesses, and probably in carbuncles and boils, the starting point of the slough which forms the core is found in a small artery plugged up by a little wandering mass of micrococci or fungous spores.

Abandoning, however, as I said before, all claim at present to certainty that the germ theory of disease is true in every detail, let us consider what modifications of the ordinary sanitary precautions we can wisely adopt in view of the probability that bacteria or closely allied organisms are the actual causes of constitutional diseases.

In the first place, it seems to me that great benefit would result from its being understood by every man, woman and child that the contagion of small pox, yellow fever, typhoid fever, scarlet fever, measles, diphtheria, cholera, etc., is probably composed of exceedingly minute seeds called spores, so small that a mass the diameter of one of the dots or periods (.) upon a printed page might contain over fifty millions.

Each one of these fifty millions of seeds is capable, under favorable circumstances, of reproducing its kind with almost inconceivable rapidity, so that supposing, for example, the zygodesimus of Prof. Letzerich is really the morbific agent causing diphtheria, a particle of the grayish false membrane which appears in the throat of patients ill with this complaint, although no bigger than the dot just mentioned, might contain separate seeds enough to infect every inhabitant of the whole continent of North America with diphtheritic disease.

The obvious deductions from these facts tend to strengthen the urgent recommendations of sanitarians that every effort should be made: 1st, to prevent these morbific germs from being let loose upon the world; and, 2d, when they have made their escape into the free air or water, to destroy all spores likely to come in contact with unprotected persons, that is to say, human beings, from whose bodies one crop of small pox (or cow pox) fungus, yellow fever bacteria, relapsing fever spirillia, etc., have not already been raised.

Each individual affected with small pox or any other of the diseases above mentioned, is, according to this theory to be looked upon as a sort of hot-bed or forcing house for the seeds or spores of that malady. From his or her body are continually given off in all directions by the skin, the breath, the perspiration, and the other secretions, millions of spores, of the extreme minuteness I have described, each one of which, if it were received into a human system under favorable circumstances, would rapidly reproduce itself, and after a few days or weeks (corresponding, as already stated, to what is known as the period of incubation) give rise to a new case of the disease again—a new hot-bed of contagion for other unprotected organisms.

Now these pores, just like the seeds of larger noxious weeds, which, when allowed to gain a foothold in our fields and gardens, propagate themselves with such immense rapidity, have no power to move of their own accord, and can only develop if they meet with air, moisture and congenial soil suited to their peculiar requirements. That is, if a small pox patient is shut up in a germ-tight room, so that the seeds cannot escape, or if whilst in the open air that air is stagnant so that no seeds are wafted away from the immediate neighborhood of the individual, or if when carried along by the wind they are blown away from any human habitation, are desiccated in a dry atmosphere, baked by the sun's rays or by artificial heat, frozen by extreme cold (as seems to be the case with yellow fever germs), or, finally, if they happen to meet with no persons but those who have had small pox or been sufficiently vaccinated—in other words, if they do not "fall upon good ground," all this wealth of provision by which nature tries to secure this perpetuation of the poisonous plant causing small pox in our systems, proves unavailing, and her malevolent design against our race, carried out with such a multitude of murderous weapons, utterly fails.

This brings me to a notice of one of the most mischievous popular errors which a general acceptance of the germ theory would necessarily subvert, namely, the belief that small pox and other contagious maladies often arise without previous exposure to the seeds of disease. This doctrine, frequently advanced in private life as an excuse for neglect of proper care and caution in regard to children, etc., and occasionally sustained by public authorities as an apology for violation of quarantine and other sanitary regulations, is exceedingly pernicious, and our warmest gratitude would be due to the germ theory of disease, even should its establishment render no other service to humanity than the explosion of this fallacy. The fact is, as I firmly believe, that (inverting the scriptural aphorism) we can as little gather thorns from grapes or thistles from figs, as we can be troubled, for instance, with germs of yellow fever growing from clean cotton, or those of cholera developing from uninfected rice.

Putting aside the primary origin of diseases, which, with one or two doubtful exceptions, is a question of prehistoric time, the germ theory teaches us that every new case of the contagious maladies already enumerated is the immediate offspring of a preceding case, and the direct result of exposure of an unprotected human being to the chance of having the spores or seeds of disease implanted in its system, an exposure which it only required sufficient knowledge, sufficient foresight, and sufficient care to avoid.

In all such instances, indeed, isolation from unprotected persons, carried out with every due consideration and kindness, is therefore to be practiced, if possible, and, under other conditions, means which will destroy the life of the spores, such as dry heat of high degree, superheated steam, prolonged boiling in water, caustic acids, or alkali, etc., are to be used with a firm confidence that if they are employed thoroughly enough they will absolutely put a stop to all spread of the disease.

A very important suggestion in regard to the use of disinfectants, arising from our knowledge of the germ theory, is that since these spores doubtless float in the atmosphere, as do the seeds of the thistle or dandelion, and are no more susceptible to the action of chemicals with which the air containing them is impregnated, it is useless to expect any certain and complete result from the milder aerial disinfectants as usually employed, that is, by scenting the medium in which they are suspended with carbolic acid, camphor, acetic acid, and similar non-corrosive agents.

As to the lesson we may deduce from these teachings in regard to public hygiene, I think its importance is only surpassed by its simplicity. For such contagious and infectious maladies it is: *Avoid at any cost the entrance into commuities of living spores, or seeds of disease.* And this should be insured, not as in former times, with the mere hope that somehow we might escape the visitation, but with the absolute certainty that with proper care infection cannot occur. No doubt many of us have smiled at the story of certain terror-stricken authorities in a German town, who, when a single potato bug was discovered in a field near them, immediately covered the whole plantation with straw soaked in kerosene, and, setting fire to it, destroyed every vestige of animal and vegetable life for acres around. And yet, if we consider a moment, we realize the fact that this apparent waste of time, trouble, and potato-vines was the wisest and most economical expenditure that could possibly have been made.

How much more, then, when our own lives and the lives of those that are dear to us, in addition to scores of millions of dollars, are at stake, as they are now in the South, should sanitary authorities be armed with almost despotic power, in order that they may shut out or kill every one of those actually visible, or even tangible, seeds of disease. Quarantine, disinfection, and prolonged detention of persons, with disinfection or frequently total destruction of goods from infected districts, is, it appears to me, the *right* of the many at the expense of the few; and even if, as I should advocate for the sake of strict justice, ample compensation for loss of time and loss of property were allowed by law to those who suffered, I believe the community at large would be tenfold better off pecuniarily, to say nothing of the far more important saving of human life and human suffering, which would be secured.—*Medical Record.*

Hyalodiscus Subtilis and H. Californicus, by F. Kitton, Hon. F. R. M. S., Norwich, England.

MY friend, Prof. H. L. Smith, in the notes to his Century III of the Species Typicæ Diatomacearum,[*] says Mr. Kitton has doubts about the identity of *Hyalodiscus subtilis* with *H. californicus.* I will endeavor to briefly state my reasons for these doubts. Prof. Bailey, in Smithsonian Contributions to Knowledge, 1854, described and figured a disc under the name of *H. subtilis.* In his description he says the valves are from .001 to .003 of an inch in diameter, the umbilicus little less than one-third of the valve. The striæ, he says, are exceedingly delicate. The markings on the umbilicus are more coarsely granular (his figure represents them as large moniliform granules like those on Weise's *Craspedodiscus radiatus.*) I have recently examined some material from the following localities—Yarra Yarra, California, and Callao, Peru, and have carefully measured the entire diameter of the valves, and also that of the umbilicus, (the measurements are in 10,000ths of an inch, and will be given thus, .5 = .0005). Yarra specimens—largest, .61; umbilicus, .34; smallest, .25; umbilicus, .14. California specimens—largest, .61; umbilicus, .28; smallest, .38; umbilicus, .16. Callao forms—largest, .78; umbilicus, .35; smallest, .54; umbilicus, .24 Although size is of little or no specific value, yet the smallest valve I have been able to find is 2.5, and the largest 2.6 times larger than Bailey's forms, and the mean diameter of the umbilicus is nearly one-half that of the valves, instead of less than one-third,[†] as he states that of *H. subtilis* to be, moreover the umbilicus shows no traces of moniliform granules. Mr. Hendry, in the Q. M. J., vol. ix, page 179, says he has examined authentic specimens of Bailey's, but they were from *California,* and not *Halifax.* Can authentic specimens of the Halifax form be now obtained? In a gathering from the Sandwich Islands, a form occurs with a small umbilicus and fine striæ, like those on *Actinocyclus interpunctatus,* Brightwell. It also has the dark coarse striæ near the centre, and is of the same pale yellow color in balsam; in fact it only differs from that form by the umbilicus. Diameter of valve .32 to .59; umbilicus, .5 to .7. The same form occurs in abundance in a slide sent me by M. Petit. A third form is also common in the Sandwich Islands material; it is decidedly smaller than either of the preceding, hyaline in color, striæ coarse, and their decussation very apparent; diameter, .29 to .35; umbilicus, .5 to .7. I have also found it in a gathering from the English Channel. Professor Bailey, *l. c.*, page 14, says that *H. laevis,* Eh., is distinguished from *H. subtilis* by its much coarser striation and broader margin (I infer from this that he has seen Ehrenberg's species, but the figure in the Mikrogeologie has, as we might conclude from the specific name, no markings), in these respects agreeing with the form from the Sandwich Islands and the English Channel, but *H. laevis* is represented with a *very large* umbilicus, occupying three-fifths of the entire disc; diameter of valve in Ehrenberg's figures, .22.

Podosira hormoides is placed by M. Petit, of Paris, in this genus (see his Catalogue de Diatomees de L'ile Campbell, etc., in des Fonds de la mer, vol. iii, 1877). He says, "the endochrome has nothing in common with that of the true Podosiras, which resembles the Melosiras."

If the presence of an umbilicus were constant, this little group of diatoms would be very well marked, but as *A. interpunctatus* sometimes has it and sometimes not, it can not be considered of any generic or specific value.

I add a few notes to the foregoing, at Mr. Kitton's suggestion, first calling atten-

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[*] American Journal of Microscopy, p. 183.

[†] There seems to be some mistake here, if .5 = .0005, then .78 would = .00078; doubtless Mr. Kitton meant to write .5 = .005, in which case the largest Callao specimens would be .0078 or 2.6 times larger than Bailey's *H. subtilis,* given by him as .003. The majority of the Yarra Yarra specimens that I have seen are about .004 in diameter.

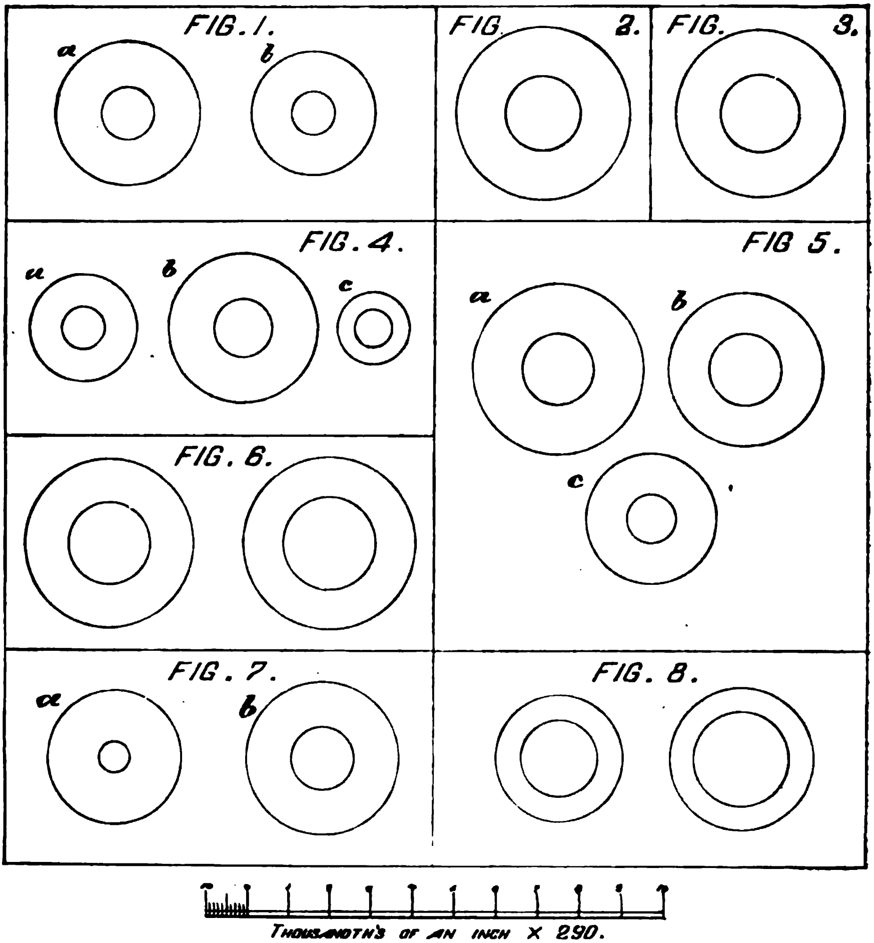

Fig. 1. Labeled *H. Californicus*, from Bailey coll. W. Sullivant.

Fig. 2. Slide marked "Halifax" by Prof. Bailey, and containing *Amphora Stauroptera.*

Fig. 3. Slide marked *H. Subtilis*, Quincy, Mass. E. Samuels.

Fig. 4. Slide mounted by Prof. Bailey—marked *Hyalodiscus*, Nova Scotia—and sent by Prof. Bailey to Mr. Chas. A. Spencer.

Fig. 5. From washing of sea weeds, San Francisco, and the *H. subtilis* of the "Species Typicæ Diatomacearum."

Fig. 6. Yarra Yarra, Australia. Dr. Coates.

Fig. 7. *H. Franklini*, No. 2 Cleve & Möller, Upsala, 1878.

Fig. 8. *H. Laevis*, Ehr., Hollis Cliff, Va.

The Figures are all drawn to same scale.

tion to a misprint which he has pointed out, of *Hyalodiscus* for *Hyalosira*, in my "Notes on Century III Species Typicæ Diatomacearum," p. 183 of this journal, No. 202, and in his letter to me he states that *Nav. cincta*, No. 256, is, according to the late Dr. W. A. Arnott, the same as the *Pinnularia stauroneiformis* of W. Smith, in the "Synopsis of the British Diatomaceæ." Dr. Arnott had an *ex cathedra* way of deciding, and in some cases (not often) was most certainly wrong. The present is one of those cases. In his description of *P. stauroneiformis*, W. Smith cites as synonym, *Nav. Brebissonii*, Kutz., from comparison with specimens which Brebisson gave to him (by what authority he ignored Kutzing's name, I am unable to conjecture), and both the description and the figure indicate plainly that it *is N. Brebissonii*, No. 254 of the "Species Typicæ Diatomacearum," and the *Nav. cincta*, No. 256, is quite another thing, though I confess I do not clearly see why Ehrenberg should give the name *cincta* to this little diatom, which I received from Brebisson, and also from Prof. Cleve, as the genuine *N. cincta* of E. As for *Hyalodiscus*, the question, as Mr. Kitton leaves it, is one of comparative size of valve and umbilicus. Fortunately I have two of Bailey's slides, containing his Hyalodiscus from Halifax—or, at least, one is marked "Halifax" by him, the other "Nova Scotia." One of these slides contains the *Amphora staurоptera* figured on the same plate with the *Hyalodiscus*, and no doubt the gathering which contained the latter was the same as that which had the *Amphora;* it has also the peculiar variety of *Grammatophora stricta*, of which he speaks in the same communication. The other slide, marked by Prof. Bailey himself, "*Hyalodiscus*, Nova Scotia," was sent to the well-known optician, Mr. Chas. A. Spencer, by Prof. Bailey, as a test. The specimens in my "Species Typicæ Diatomacearum" are from algæ gathered near San Francisco, Cal.; besides these, I have Kjellman's gathering from Finmark, the original of the specimens "No. 2, Cleve & Moller," also a slide marked by the late W. Sullivant, "*Hyalodiscus Californicus* from Prof. Bailey's collection," and another marked "*H. subtilis*, Test," mounted by E. Samuels, and labeled "Quincy, Mass.," and several gatherings from Yarra Yarra, Australia. To exhibit to the eye at once, more clearly than can be conveyed by any description, the relative appearance of forms from these different localities, I have sketched by the camera, all to the same scale, the outlines shown on the plate; and I add, also, the *H. laevis* of Ehrenberg, from Hollis cliff. Figs. 1, 2, and 4, are from Prof. Bailey's slides, and 2 and 4 are *marked by him.* I have not found any discs quite so small as Bailey names, *i. e.* .001 inch, but it will be observed that the umbilicus of *c*, Fig. 4, is fully half the diameter of the valve, and that of Fig. 2 is much more than one-third the valve; the majority, however, of the Halifax forms, have the umbilicus about one-third the diameter of the valve. If we examine Fig. 5, the San Francisco specimens, only one of them, *b*, has the umbilicus about half the valve, while that of *c* is but a little over one-third, and that of *a* is between. The Massachusetts specimens, Fig. 3, agree pretty well with the Yarra Yarra, Fig. 6; the umbilicus is nearly or quite half the diameter of the valve. Prof. Cleve's specimens, Fig. 7, have upon the whole a much smaller umbilicus, but there is not much difference between *b* Fig. 7, *a* Fig. 5, and *b* Fig. 4, as to relative size of valve and umbilicus; certainly not so much as between specimens in Fig. 5, e. g. all from same locality, or Fig. 7, where we have two extremes, or *a* and *c*, Fig. 4. Prof. Bailey's figure, alluded to by Mr. Kitton, does indeed show the umbilicus as coarsely granular, and radiate, but I can assure Mr. Kitton that it is not so. In all these forms, the umbilicus is finely and irregularly, or wavy, punctate; large granules are indeed sometimes to be observed, but their presence and character depend much on the mounting. When the frustule is dry, and unburnt, they can be seen irregularly scattered over the umbilicus, as though certain portions had imbibed moisture; thoroughly burned, these granules disappear, and the umbilicus is very slightly different in color from the rest of the valve, and with a tolerably smooth outline; in water, and also in balsam, the difference in color is striking, the umbilicus is much darker, and its outline now becomes ragged, and in many specimens there are myriads of apparent granules around the margin of, and sometimes within, the umbilicus, and in fact I have noticed the latter change its outline and size, apparently by imbition of water into the absorbent centre which constitutes the umbilicus, and which appears to underlie the central part of the valve, the markings of which can sometimes be seen running over it.

It really seems to me that there is no good reason for considering the *H. Californicus* distinct from *H. subtilis*, or, indeed, from *H. Franklinii*. The specimens from Callao I have not examined. As for *H. laevis*, which is by no means so coarsely marked as Bailey indicates, and has a narrower instead of a broader margin, I have made no study of it, but I am not sure that we ought to exclude it. No microscope used by Ehrenberg, with central illumination, would show the lines on the valve, and the specific name, *laevis*, might be well applied to the whole group. H. L. SMITH.

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Notes on Microscopic Life in the Buffalo Water Supply.

BY D. S. KELLICOTT.

IT is not intended in these notes to enumerate all the forms of minute life in the Buffalo water supply, but to state some general facts acquired by a somewhat careful study of the same during a period of three or four years. I compile these notes, primarily, that I may add, it may be, a grain or so to the amount of knowledge of "Pond and Stream Life," which branch of investigation seems to be gaining favor amongst us, or what is more nearly the truth, as it seems to me, our observers are beginning to publish more freely their observations.

Buffalo is supplied with most excellent water from the Niagara River. It is withdrawn through an "inlet pier," eight hundred feet from shore; the water enters the pier through a gate four feet below the surface, and twenty feet from the bottom of the river. The river's velocity at the pier is seven or eight miles per hour. The water to the faucets used in these observations is pumped direct, without filtering or settling, by the "Holly system." The sediment was obtained by letting a stream the size of a crow-quill fall into a muslin bag for a stated period, then stopping the flow, and after agitating the water in the bag, sucking up water and sediment with a wide ball-pipette. After trying other methods of concentration, I prefer this one when the object is to secure the living forms. It should be kept in mind that the Niagara is the outlet of four of the great North American inland seas of fresh water; that its area of collection embraces prairie and forest through ten degrees of latitude; that it scarcely notices droughts or freshets; that the character of the water is sensibly affected, save in temperature, only by the moving ice from the lakes in spring, or by the phenomenal "Buffalo zephyr." These characters are peculiar.

The area of collection is so extended that the presence of numerous species and many individuals would naturally enough be anticipated. Such is the case. In general there is more life in winter than in summer, but autumn and spring afford the greatest number of species.

One of the most notable peculiarities is periodicity of species. Certain ones, usually few in number, appear throughout the year, while others occur at well-marked periods. Some of these migrating species appear in their day literally in hosts, while others are few at their best. The above applies to both vegetable and animal forms. A few examples are as follows: *Stephanodiscus Niagaræ*, so characteristic of this water supply, begins to appear in force the latter part of September, and continues till March; during February there are multitudes, so abundant are they that the muslin bag used for concentrating them is clogged in a very brief time. The habitat of this diatom is about the upper lakes (Briggs, in "Lens,") where it probably grows in winter and spring, starting on its down voyage in early summer, and reaches this point after six months more or less. *Melosira varians* is another diatom that periodically loads the water; it occurs twice in a year, viz.: for some weeks in autumn, and again for a short time in May. Both forms referred to above may be found in the water at any time, but their notable appearance is as stated. Further they are the only diatoms that ever swarm our hydrant water. *Rhizosolenia Eriensis* and *Amphiprora ornata* are both seen occasionally through the year, but in October and November are quite common, especially the former. *Surirella splendida*, *S. ovata* and *Surirella* ———— appear sparingly in autumn, rarely at other times; while *Asterionella formosa?*, *Fragilaria capucina*, *F. Crotonensis*, *Tabellaria* (two species), *Cyclotella operculata*, *Cymatopleura solea*, and others appear all the time without much variation. Among animal forms the following, among others, are numerous at times. *Cyclops quadricornis* is always common from the latter part of December until the ice clears from the lake in spring; they are found in all stages during this time. They are driven, it seems to me, from the shallow waters of shore, pond and creek, to the warmer water of the lake, and so appear in our hydrants at the time stated above. Another entomostracan, *Bosmina longirostris*, is present during the first half of October; sometimes there are very many. I have never seen this species at any other date.

The "flowering animalcule," *Dinobryon sertularia*, occurs occasionally throughout the year, but late in May, or early in June, is exceedingly abundant. The flagellate infusorium, *Ceratium longicorne*, is another periodical visitant; I have recorded it as common or abundant at different dates between September 10th and November 15th. It is rare at other times. Other examples could be given.

Diatoms floating in rivers are supposed to have grown attached to objects, or on the mud along their borders, or in springs and tributary brooks, and having reached the free stage, were swept along with the current. If the free diatoms in the Niagara are thus derived, but few species growing in its tributaries reach it; and very few of those growing along its own borders find their way into our hydrant water. *Gomphonema olivaceum*, *Meridion vernale*, *Synedra radians*, *Cocconeis elliptica*, and others, are exceeding abundant in their time in the river about Buffalo, yet they are comparatively rare in the supply.

A species of *Hydra* comes along now and then. During the first week in June, 1877, scores could be taken in an hour's flow from the faucet. At no other time have they appeared in such numbers.

Vorticellas are sometimes common, especially a small one which is usually attached to diatoms, etc. I frequently meet them towing a *S. Niagaræ*, and it is a singular fact there are more often two than one attached (on opposite sides) to the same frustule.

The *rotifers* are pretty well represented, *i. e.* the number of species.

Besides *Difflugia cratera*, which is at all times not uncommon (carapace) there are very few protozoans. Occasionally a small crustacean comes through the faucet bearing on its surface numerous individuals of a beautiful *Acineta*. (It agrees well with *A. tuberosa*, but it is put down as inhabiting salt or brackish water).

Desmids are never common. Several species, however, are almost always present, *e. g. Closterium lunula* and others, *Staurastrum gracile* and others, *Pediastrum Boryanum* and another, and so on.

Low infusorial forms are seldom seen, in fact, very few forms appear which are common in suspicious waters. · Ugly looking "worms" sometimes appear, such as *Auguillula fluviatitis* and *Tubifex* ————; sometimes, also a *tardigrade;* but they are not alarming, as they are liable to occur in potable water from any source. I have found them common enough in wells, which chemical analysis placed above suspicion.

There are always present fungal spores, etc., etc.; among these *may be* mischievous "germs of disease." Who knows? We need more knowledge concerning them. When their history and relation to disease are known, the sanitarian can use the microscope to good purpose.

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The Woodward Prism.

THIS little accessory to the microscope bids fair to supersede all other modes of sub-stage illumination, and to make unnecessary several rather expensive bits of apparatus. By its aid the less complicated forms of the instrument are made as available for nice test work as the most elaborate, and in the simplification of the scientific man's working instruments, a real and positive improvement is effected.

As originally designed and mounted, it was a plain right-angle prism, with an arm carrying pin-hole diaphragms at right angles to one of the facets, so that only a minute ray of light could reach the object on the slide, and that at an angle in excess of the maximum which corresponds in balsam or glass to the 180° air angle. Its purpose was to demonstrate the fact that wide-angled glasses are actually made, by which available, image-forming rays are utilized beyond the maximum air angle. It thus played an important part in the celebrated controversy with Mr. Wenham on the angle of aperture question, in respect to which the position originally taken by Mr. Tolles. Dr. Woodward, and Prof. Keith, in this country, has finally become the received doctrine in Europe, Mr. Wenham being overborne by the combined authority of Prof. Abbe, of Jena, and Prof. Stokes, of Cambridge.

But the Woodward prism, having served its purpose in the "Battle of the Angles," its designer found that as a practical instrument, used without the diaphragms, it afforded the best means of securing oblique illumination, not only for test work upon diatoms, etc., but for all kinds of delicate observations upon thin tissues, and striate, ciliate or flagellate bodies.

It may be safely asserted that for whatever purpose the Wenham reflex illuminator is useful, the Woodward prism is superior; and we have no hesitation in predicting that it will eventually supersede, also, the paraboloid for dark ground illumination with low powers. Indeed there is hardly one of the elaborate and expensive sub-stage illuminators whose work cannot be better done by this amusingly simple accessory, which can be so cheaply made as to form part of every outfit for a Student's microscope, being in fact less costly than the very cheapest achromatic condenser furnished with an educational instrument.

For instruments having a movable sub-stage, the prism is mounted in a Y shaped saddle on the end of a steel wire which slides in the arm of a dark-well holder, or in a cork or wooden plug fitted to opening of the sub-stage. It can thus be racked up to the bottom of the object slide, and the immersion connection with water or glycerine, which is essential, can be most readily made.

For the plain thin stage without stage movements, like Zentmayer's Histological, a plate is clamped by a set-screw to the under side of the stage, and this plate carries a bent arm with a hole in which the supporting pin of the prism slides. This form has recently been furnished by Mr. Zentmayer for Prof. J. E. Smith.

Another form designed by Dr. Woodward for Student's stands, is to have the prism set in a circular plate, which fits to the under side of the stage by a bayonet catch, the setting being such as to leave room for the film of glycerine between the prism and the object slide when in place.

Simplest of all is the plan adopted by Mr. Geo. Wale, of Paterson, N. J., who makes the prism small, three-eighths by a quarter inch, without any mounting whatever, the glycerine being adhesive enough to hold the prism in contact with the slide. With a little care and skill in manipulating, this method is as successful as either of the others, and reduces cost to the minimum, whilst it makes the prism available upon every cheap thin stage microscope.

By cutting the angles of the prism to suit the aperture of the objective, the very best work of which the glass is capable may be brought out, whether its angle be high or low. If the observer's best glass has an aperture less than 180° air angle, the acute angles of the prism may be made less than the standard of 41°, which is the form corresponding to the maximum air angle.

The peculiar usefulness and advantage of the prism seems to depend upon the fact that the light being sent from the mirror or condenser at right angles to the facet, no refraction occurs, and the rays go straight to the object without interference, mingling or diversion. All the sub-stage devices, whether kettle drums, hemispherical or other plano-convex lenses, paraboloids, hollow or solid, are inferior in this respect, and for ease of manipulation and certainty of working there is absolutely no comparison.

It will at once be seen that it is easy to have the two working facets of the prism cut at different angles, so that by simply turning it over, a higher or lower angle may be used. Practice proves, however, that it is not best to have more than one facet on one side of the prism, as it interferes with the purity and directness of the light, by breaking up the rays and more or less crossing the lines of illumination. The triangular form is at once simplest and best.

We see no reason why a very flat form of the prism with angles of about 25°, might not prove excellent as an illuminator for the binocular instrument, the light being received in the direction of the optical axis of the microscope by parallel rays from the mirror or bulls-eye condenser properly placed.

The same result would thus be reached as Mr. Tolles has secured by the use of two mirrors at once.

In short, we are confident that no piece of apparatus will prove so indispensable and variously useful as this most simple of accessories. J. D. C.

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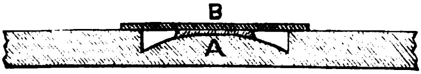
The Weber Slide.

THERE is no doubt in the minds of those who use the microscope that living objects, whether animal or vegetable, are by far the most interesting, especially to beginners, and a simple and inexpensive means of preserving and exhibiting them has long been a desideratum. The well-known live-box or animalcule cage serves the purpose very well, but it is expensive, and does not entirely prevent the evaporation of the liquid in which the objects are contained. The ordinary concave slide, though better than a plain slip of glass, does not fulfil all the requirements, and with such a slide it is difficult to keep the object in focus, except with very low powers.



THE WEBER SLIDE.

To obviate these difficulties, Mr. Weber has reversed the form of the cell, and forms his slide as shown in the accompanying engraving, where A is the convex bottom of the cell, and B the thin glass cover—a drop of water being held between them by capillary attraction. When the cover is cemented down by means of a little waterproof cement, the water cannot evaporate, and the whole arrangement forms an air-tight aquarium on a minute scale. The open space forms a chamber which retains a supply of air, and if the animal and vegetable life are properly balanced, life may exist in one of these slides for weeks. Indeed we have been surprised at the length of time that they keep in good condition.

In the engraving, which shows the slide as manufactured by Mr. C. F. Prentice, of this city, the thickness of the slide, etc., is magnified about four times.

Carl Zeiss' New Oil-Immersion Objective of 1-12th inch Focus, No. 5.

IN No. 683 (letter 14253) of the *English Mechanic*, I reviewed a new oil-immersion objective of 1-8th inch focus, and I expressed then the hope that Prof. Abbe and Mr. Zeiss might soon succeed in constructing higher powers than the 1-8th on the oil-immersion principle. This hope has recently been realized by the production of a 1-12th, of which I received a specimen some weeks ago, and of which a short notice may be of interest to microscopists.

This new object-glass is similar in external appearance to the 1-8th referred to, the optical combination being contained in a brass setting barely three-fourths of an inch long, which is screwed to an adapter provided with the universal screw, and which gives to the whole the appearance of an English objective. The front lens has a diameter of about 1-12th inch, and is set in a white metal front. The workmanship is in every respect of the best kind. This 1-12th has, like its predecessor, the 1-8th, no screw collar, as its front lens has to be immersed in a small drop of cedarwood oil, whose refractive power is practically equal to that of crown glass, of which both front lens and the covering glass of the object consist. Any small correction necessary has to be made by means of the draw-tube. For observations by central light a more dispersive fluid is required in order to secure an image free from chromatic aberration, and such a fluid can be obtained by mixing together fennel-seed oil and clear olive oil in a proportion which can be readily ascertained by means of a bottle having two ground parallel sides, and a crown-glass prism cemented to its stopper, which Mr. Zeiss supplies along with his oil-immersion lenses. I find the magnification of this new 1-12th with Ross' A eye-piece, at a distance of 10 inches from the latter, to be fully 580 diameters, and the working distance about 1-13th inch. The angular aperture is stated to be the same as that of the 1-8th—viz., equal to a balsam angle of 113°, and considered, according to its "numerical value," larger in the proportion of 1.25 to 1, or of 5 to 4, than that of a dry objective of 180° air angle. To insure the greatest possible resolving power of these oil lenses, it is necessary that the objects should be mounted in balsam or in any other medium having a refractive index of, at least, 1.25; or, if mounted dry, that they should adhere closely to the cover.

I am happy to be able to state that I find the optical qualities of this new lens in every respect equal to that of the 1-8th previously described. The field is perfectly flat, and the brilliancy and definition leave nothing to be desired, whilst the resolving power is extraordinary. All the finer diatomaceous tests, such as *Amphipleura pellucida*, etc., are resolved with the greatest ease and with the utmost distinctness; and, although I have hitherto failed to see, both with the 1-8th and the 1-12th oil-immersion lenses, more than with Powell & Lealand's excellent new formula or some other first-class water immersion lenses, yet I see everything better and easier than with the latter. For the resolution of the markings on diatoms, no better lenses could be desired than these Zeiss' oil-immersion lenses.

Nearly all that I stated in letter 14253 about the 1-8th is applicable to the new 1-12th, and I beg to refer both to that letter and to abler articles on the new 1-8th oil immersion lenses which have appeared in the *Journal* of the Royal Microscopical Society.

It is to be regretted that Prof. Abbe and Mr. Carl Zeiss deem it inadvisable to undertake the construction of microscopical objectives of yet higher power on the oil immersion principle. This they do, however, both on account of practical difficulties in the production of still smaller lenses, and because no greater angular aperture could be gained than those of the ordinary largest angled water-immersion lenses.—*Adolf Schulze in English Mechanic.*

The "Oil-Immersion" of Carl Zeiss compared with the Objectives of C. A. Spencer & Sons.

BY PROF. H. L. SMITH, LL.D.

SOME four months ago I sent two objectives, by special request, one to Belgium, the other to Germany. They were made by C. A. Spencer & Sons, and were then highest grade, having a balsam angle of about 102°. I say their then highest grade, as they have since brought out a 1-6th, and also a 1-10th on a new formula, having a balsam angle of near 110°. One of the objectives sent to Germany was compared with the new "Zeiss oil immersion" by a personal friend of mine, not the owner of this objective; he pronounced it an excellent glass, but, to use his own words, "a long way behind his Zeiss oil immersion." I felt inclined to accept this decision, though the Messrs. Spencer assured me that there must be some mistake; yet, from the very high reputation of M. Zeiss, and especially from his connection with Professor Abbe, in the production of the new objective, I was prepared to admit that he had, really, made something of surpassing excellence, which would easily beat any competitor. True, Mr. Dallinger's report upon this objective showed that, upon the whole, the new optical wonder of Jena did not quite equal the Powell & Leland "1-8th new formula," but then I had not seen any of these new formula objectives of the world-renowned English opticians, and as the same able and wholly competent judge had decided that Mr. Tolles' 1-6th was not quite up to this "new 1-8th," though pressing it very closely, I felt inclined to believe that, really, M. Zeiss *had* stolen a march on the Americans. For the purpose then of satisfying myself, and for the grim satisfaction of convincing the Messrs. Spencer, I purchased in London a "1-20th" immersion by Zeiss, with the express notice that it was to be tested against the best American objectives, and more recently induced a friend, who had just received the "new oil immersion 1-8th," to send me that for examination. The 1-20th proved to be a good objective. I did not feel like complaining that I had not the worth of my money, but it was not so good an objective as I could have procured from either Tolles, or Spencer, though of higher numerical grade than they would have furnished for the same money. It proved certainly that M. Zeiss was an excellent workman, and as I have said, I did not feel disposed to think I had paid too high a price, as Franklin has it, "for the whistle;" but I did expect to see something far superior to the 1-20th when the "oil" should arrive. This indeed proved to be the case, and I have no hesitation in saying, and all who have looked through it here agree with me, that up to this time, the new Zeiss "1-8th oil immersion" is the best foreign made objective I have seen. The mechanical work is very good, the appearance neat, and the lenses, when tested on the artificial star, appear to be very well centered and figured, and the coma is inward and not excessive. So far as could be judged from outside appearances, for I made no attempt to unravel its mysteries of structure, it is what is now called a "three-system" objective, though M. Zeiss in his circular mentions it as a "four-system;" the front lens is, apparently, too large for any "four-system" construction of equivalent focus. Considering the inexpensive character of the mounting, compared with the elaborate and nice workmanship required for the mounting of a first-class 1-10th or 1-6th, this objective is put at an exceedingly high price—240 thalers in Jena, say $60 gold, to which must be added duties, etc., if imported in the *regular* way. It *ought* to do superior work. The balsam angle of this objective, *i. e.* the angle of the emergent cone *in* balsam as actually measured, is the same as that of a 1-10th Spencer, belonging to a gentleman of this place, which was made at the same time with, and indeed is the same in every respect as the two objectives I had sent to my friends in Europe. With this objective I compared the new Zeiss, and also with a 1-6th of much larger balsam angle, not yet completed in its own mounting, though finished optically. I beg here to say that I am no partisan, either of the Spencers, or of Mr. Tolles; I do not own an objective made by either of them, higher than a 2-3d of 35°. With my friend, who owns the "Zeiss," I believe in the "survival of the fittest." I am only interested in seeing fair play, and I am sure that neither M. Zeiss, nor my friend in Germany, who endorsed him so highly, in the comparison with the American objectives, will question my right either to criticize or to publish the result, so long as I state facts which rest not alone on my own testimony, though I may be pardoned for saying I deem that sufficient. The objectives were tried in as precisely similar conditions as possible. The same frustules of *Amphipleura*, the same light—alternately changing the objectives with direct (axial) light, and with oblique, by daylight and by lamp light. With the mirror alone, and with the "Wenham reflex." And this not once, but a great many times. The tests were both dry, and balsam mounted, *Amphipleura*, and for the axial light I had a remarkably excellent specimen of the *Podura* scale. With the daylight used in any way, the 1-6th and 1-10th were manifestly superior to the Zeiss. Fortunately, I am relieved of any charge of improper manipulation, as the "Zeiss" came furnished with oil specially prepared for it, and needed no manipulation. There was nothing to do but change the objective, and make the "oil," which is abominably thin and runs almost like alcohol, stay in, especially with thin covers, and the stage at all approaching the vertical; this feat, however, was successfully accomplished, and I may add, that before applying the oil, the slide was thoroughly cleaned, so that no remnants of the glycerine, or water, used with the other objectives, should interfere; a process also necessary on again changing from the "Zeiss" to the "Spencer." If I knew how to do a fair thing, I am sure it was done at this trial, and I freely confess the result is not what I anticipated. With the Spencer objectives, the outlines of the frustule, and the lines themselves on the valves, were much more sharply defined than with the "Zeiss." There was no difficulty at all, with mirror alone, and ordinary sky light, in resolving the *Amphipleura* dry, with the "Zeiss," what would have been called superior resolution, if it had not been seen better with the same light, without touching the mirror, with the Spencer objectives. There was a smoky appearance with the "Zeiss" on the dry mount, and an indistinct outline of the valves, with a tendency to break down with the E eye-piece, which was entirely absent from the two objectives compared with it.

The lines were also seen on *Amphipleura* in balsam, by daylight, but requiring much stronger light to see them best with the "Zeiss," indeed, closer vicinity to the sun than with the "Spencer," the latter exhibited here also the lines considerably sharper. With lamplight and mirror, the results were the same, all the objectives resolved the balsam mounts, but the difference was unmistakably in favor of the 1-10th and the 1-6th. With the Wenham reflex, tried many times on the balsam-mounted *Amphipleura*, the "Zeiss" did its best work, and more nearly equaled the 1-10th than it did the 1-6th; but still here, the American objectives not only showed the markings blacker and finer, but stood the test of deepest eye-pieces without flinching, better than the "Zeiss." In all these trials other witnesses were present, and the difference was clearly recognizable—markedly so with ordinary daylight and mirror.

On *Podura*, after what I have already said, I need scarcely remark that the same difference was apparent. Indeed, as the same oil is not suitable both for extreme and for central illumination, and I had but that which the owner of the objective sent with it, it is not, perhaps, fair to M. Zeiss to dwell too strongly upon this test. Now, in all I have said, I beg not to be understood as depreciating the Zeiss objective. It is, by far, the best foreign objective I have ever handled. There was a satisfaction in being relieved from any responsibility in adjusting. For my own part, I felt so much satisfaction in this, that I hope the Spencers may be induced to make similar objectives. Finally, it must be remembered, even granting for a moment that my excellent friend in Germany did succeed in resolving test objects much better with the "Zeiss" than with the "Spencer," that the latter was also a very good objective as a dry, and there are hundreds of cases where an oil, which dissolves balsam, and asphalt, etc., cannot well be used; or possibly he may have employed water as the immersion fluid, which is only proper for direct (axial) illumination, instead of glycerin, which is necessary for very oblique illumination.—*Am. Quar. Microscopical Journal.*

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An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Deferred.

WANT of room has compelled us to hold over a large amount of matter this month.

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The January Number.

THE number of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878, is entirely out of print, and we can no longer supply it to subscribers.

We will gladly pay ten cents apiece for clean copies of the AMERICAN JOURNAL OF MICROSCOPY for January, 1878.

A Correction and an Apology.

WE greatly regret that in our last issue we failed to credit the article on the *Volvox Globator* to its proper source. It was written for the *Popular Science Review* (Messrs. Hardwicke & Bogue, of London), and was taken by us from that excellent journal. The failure to credit was due to an accident, and when discovered was a source of great mortification to us.

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A Correction.

IN the reports of the New York Microscopical Society, published by authority by Hitchcock & Wall, of this city, the following statement is attributed to the editor of this journal:

"Prof. Phin discussed the subject of fine ruling, and stated that the difficulty in making micrometers was not in securing accuracy of spacing, but in determining the true value of the divisions of the unit."

The discussion did not at all relate to the *making* of micrometers, but to their examination and verification, it having been proposed by Prof. Hitchcock that the society should stamp with a special label, copyrighted by the society, such micrometers as they saw fit. Whether these stamped micrometers were to be issued on the authority of the society or on the authority of some one else, it is difficult to determine, but from Prof. Hitchcock's estimate of the ability of the members of the society, it is to be presumed that they were expected to rely on some one else. Prof. Hitchcock's opinion is that "there is no member of the society sufficiently experienced in making minute measurements, or familiar with the means of dividing up a given space," to be justified in making an attempt to verify the accuracy of any micrometer by independent observations from the U. S. standard.

What the editor of this journal did say was as follows:

"There are two important features in every micrometer, one being the accuracy with which it conforms to a given standard, and the other being the equality of its divisions amongst themselves. An examination of the first point is in general beyond the means at the command of working microscopists, but the degree of accuracy with which any given space is divided may be easily determined by means which can be extemporized by any one."

It may be well, also, to call attention to the statement attributed, in the same report, to Mr. Haswell. The report reads:

"Mr. Haswell drew attention to the new standard measure of Capt. Clarke, which he thought would be adopted universally before long."

Mr. Haswell is too well informed to have made any such mis-statement. Capt. Clarke has not made any "new standard measure." He has merely compared the metre with the yard, and given us a very accurate expression of their relations. It was to this expression, published in the last number of this journal, that Mr. Haswell referred.

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Our Book Table.

The American Quarterly Microscopical Journal, Containing the Transactions of the New York Microscopical Society. Edited by Romyn Hitchcock. New York: Hitchcock & Wall.

This elegant quarterly is certainly an honor to American journalism. The paper and printing are better than can be found in most scientific journals, and some of the plates are remarkably fine, particularly the steel engraving of new diatoms, illustrative of an article by Prof. H. L. Smith. Some of the lithographs might perhaps be improved with advantage. The new journal is intended to occupy ground entirely different from that now covered by the AMERICAN JOURNAL OF MICROSCOPY, which has endeavored to publish news rather than monographs. The latter is the avowed sphere of the new Quarterly, and we wish it abundant success.

The Amateur's Handbook of Practical Information for the Workshop and the Laboratory: Containing clear and full Directions for Bronzing, Lacquering, Polishing Metal. Staining and Polishing Wood, Soldering, Brazing, Working Steel, Tempering Tools, Case-Hardening, Cutting and Working Glass, Varnishing, Silvering, Gilding, Preparing Skins, Waterproofing, Making Alloys, Fusible Metals, Cements, Glues, etc., etc. Price 10 cents. New York: Industrial Publication Company. 1878.

This is not a mere book of recipes clipped from old journals and encyclopædias, but a carefully compiled book of instructions for performing those little technical operations which are so frequently required in every-day life, and in the workshop of the amateur. In most of these operations the recipe is but half the battle; when we come to put it in operation we are apt to fail from ignorance of some general principle, or from inattention to some important though apparently trifling detail. In the book before us this defect is avoided, and minute practical directions are given, so that any one may be able to put the recipes in practice. This is specially apparent under such headings as glass-cutting, lacquering, steel working, brazing and soldering, silvering, staining woods, waterproofing, etc.

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Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

On Objectives.

Ed. Am. Jour. Microscopy—In the May number of this journal there appeared a short article on angular aperture, considered in relation to an ideal set of objectives; in the June number a letter of reply to this, written by Prof. Smith, and in so friendly a manner that it could scarcely be called criticism. The following is, perhaps, a too tardy reply to Prof. Smith's letter.

Prof. Smith asks whether "Mr. Lapham does not attach too much importance to penetration." The particular degree of importance will vary, no doubt, with every object observed. In very many cases penetration is injurious. Every man must decide for himself its value to him. In the department of proto-biology, or the study of the lower forms of life, I find it of great value.

Prof. Smith has a theory of his own in regard to the relation existent between penetration and working distance, which he states as follows: "We will take, for example, two glasses, both possessing the same amplifications and the same apertures; now of these two glasses, the one having the greater working distance will exhibit structures situated slightly out of the precise focal plane, or what amounts to the same thing, will be less susceptible to slight changes in the focal distance, or, again, to use the words of Dr. Carpenter, will have the greater penetration." Immediately afterwards he says: "In extreme cases the item of aperture may be disregarded altogether." I cannot see what he means by this last sentence, inasmuch as he, *in every case*, disregards the aperture, or else gives up his theory. This he will allow me to state as follows: "Penetration varies with working distance, becoming greater with increase of distance, less with its decrease."

This is not far from true, for the reason that, as a rule, angle of aperture varies inversely with the working distance, becoming less as working distance becomes greater. Now the relation existent between angular aperture and penetration is without any doubt as follows: "P. varies inversely with A. A., becoming greater as A. A. grows less."

Therefore if A. A. *always varied* inversely with the working distance, Prof. Smith's theory would be established by the simple formula—A. A. varies inversely with W. D., P. varies inversely with A. A.; therefore P. must vary with W. D.

But by Prof. Smith's own statement of his theory, A. A. does not always vary inversely with W. D. Therefore P. does not always vary with W. D. Before Prof. Smith can ask us to accept his theory, therefore, he must demolish a particularly huge obstacle to it, in the shape of the mathematico-optical truth, that penetration varies inversely with angular aperture. Being myself ignorant of optics, I desired to make some practical investigations into the truth of his theory, but have been unable to do so until to-day, when a single experiment proved it to be untrue.

Reducing, by a diaphragm, the aperture of Tolles' one-inch of 30° to *about* 15°, I found that *while the working distance remained the same*, penetration was greatly superior. I could not determine the *precise* amount of the latter, but it was about twice as great as that of 30°. Penetration, therefore, does not vary with working distance, since it would, in that case, have remained the same with 15° as with 30°.

In connection with this experiment, there arises an important question as to whether penetration might not always be secured by means of diaphragms, thus doing away with the need of buying glasses especially for that purpose. I have spoken of the "best possible corrections," and mean by this such corrections as will secure the best possible definition. It is well known that an absolutely achromatic glass cannot define delicate structures as well as one not quite so perfectly corrected. Tolles' one-inch of 30° defines such structures precisely, because of a certain amount of color error, and I think it probable that ever so scientific an application of a diaphragm to it would change this precise amount of error, thus injuring that quality of greater importance than all others combined, definition. This, however, is only a theory of mine. I could not apply the diaphragm with accuracy sufficient to demonstrate its truth or error. So far as the experiment was concerned, it indicated its truth, since the definition grew worse as aperture grew smaller.

But there is another objection to the procuring of penetration by means of reducing the aperture of a high-angled glass. This is noted by Dr. Carpenter, who writes to the effect that "a 4-10th of 40° has this great advantage over one whose aperture has been reduced to 40° by a diaphragm, that its working distance is so much greater as to allow of the far more easy illumination of opaque objects by the bulls-eye," (I quote from memory).

Prof. Smith says, "Penetration, unless accompanied by a certain amount of definition, is practically worthless." It is evident that a definition of penetration has become necessary. I quote, from memory, that of Prof. Rutherfurd: "Penetration is the seeing, *with tolerable distinctness*, of points situated above or below the exact focal plane." Now, by "certain amount of definition," Prof. Smith can only mean "seeing with tolerable distinctness." It is clear then that there can be no such thing as penetration unaccompanied by a "certain amount of definition." The meaning of "tolerable" will, of course, vary with the view of the object desired. As a rule, we do not much care about studying minute structure, when trying to make out the solid form of an object. In other words, the study of space in three dimensions is something quite different from the study of space in two dimensions. Prof. Smith says: "The point I have to make is this—the 1-4th of 50° will have the greater penetration," (as compared with a 4-10th of 100°), "*but will lack definition*, to the end that more is lost in the latter element than is gained in the former."

This is to my mind possible only on condition that a higher power eye-piece be used with 1-4th than with 4-10th; or that the 1-4th be corrected with less skill. But the fact is that the higher power eye-piece must be used with 4-10th in order that its amplification may be as great as that of 1-4th, and I do not see how Prof. Smith can imagine (if he does imagine) that a 1-4th of 50° cannot be made to define as well as any other glass.

Prof. Smith means to say perhaps that it cannot be made to define the markings on *Podura*, or the dots on *P. angulatum*, as well as the 4-10th, and here he would be correct. But no one would think of using a 50° glass for such purposes. It must be understood that resolution refers merely to seeing, definition to the manner in which a thing is seen. I never yet saw a glass in which the limit of definition coincided with the limit of resolution. In other words, every glass will show the mere existence of structures which it cannot show with perfect clearness.

Now, when it is said that such or such a glass defines in a superb manner, it is not meant that it defines *everything* in this manner, but only such structures as are suited to its angle, it being a law that the higher the angle the better the definition of structures *of a certain degree of difficulty*, although that of ordinary structures is not improved thereby. If, therefore, the definition of 1-4th of 50°, as tested by objects not in the least degree, to it, difficult of resolution, is equal to that of 4-10th of 100°, as tested by other objects similarly related to *its* resolving power, it cannot be said to be unequal to it on account of its not defining certain tests with which the 4-10th has no difficulty.

Prof. Smith speaks of a 4-10th of 100° as being a *luxury*. I do not expect many to agree with me, but to the student of living forms no glass can be of so great value (I speak now of Tolles' 4-10th, not knowing how it compares with others.) This glass, under 1-2 inch eye-piece and amplifier (1,000 diameters), *defines* the markings on *Podura* in a superb manner. (I have seen *Podura* shown by Prof. Smith, and by Dr. Edmunds in London. There are, perhaps, no better manipulators in existence, and they used the finest glasses.) I have also myself made many tests to see how much was gained by the use of a 1-6th and 1-2 inch eye-piece (1,200 diameters), as compared with a 4-10th, 1-2 inch eye-piece, and amplifier (1,000 diameters).

I have not seen a finer glass than the 1-6th of which I speak, but the 4-10th not only defines *Podura* and other tests in an astonishing manner, nearly equaling 1-6th, but it does this *over the whole field*, and its penetration is much greater; this with a working distance sufficient to work through an ordinary slide, and, when needed, a blinding glare of light. This last is of importance for showing structure of thick sections and partially opaque objects in general. The working distance can only be appreciated by those who make considerable use of deep cells).

But 1,000 diameters is twice as high a power as commonly needed, and when it is said that one can go, with this glass, through every amplification down to 100 diameters, and with better definition at every step, it amounts to a demonstration that there can be no more valuable glass than a 4-10th of 100°.

W. G. Lapham.

Tubingen, Germany, Oct. 15, 1878.

A Query for Mr. Merriman.

Ed. Am. Jour. Microscopy—In his paper on "Mounting," read before the Indianapolis Congress, Mr. Merriman speaks of working the shellac varnish, or Thiersch's cement, "into a narrow ring with the point of a small knife blade held on the turning slide." He also speaks of using balsam in the same way.

My experience leads me to inquire for more particulars, especially as to the means he uses to prevent the smearing of the slide, or to clean perfectly the circle outside of the cell, where the cement spread before it was gathered up into the narrow ring. 1st. Does he work up the cement with the knife while still wet? 2d. Will not alcohol or anything else used to clean the slide around the cell make more "muss" than it cleans, by dissolving the cement?

Turntable.

Mr. Merriman's Answer.

Ed. Am. Jour. Microscopy—1st. The consistence of the shellac cement which I have found the best for the purposes of cell-making, is that in which the cement will scarcely move when turned up. As the alcohol dries out, this material seems to form a kind of liquid jelly; and this is the state in which it may be worked up into cell rings on the turn-table most readily, and with the least liability to air bubbles. Canada balsam, for finishing the cells, must be diluted with turpentine until it flows quite readily. It can then be turned up to the cell with the point of a knife, forming a very beautiful finish.

2d. The best way to clean slides from superfluous cement, in this case and in all others, is to wait until it is dry, or so nearly so that it can be all removed by the edge of a knife-blade, carefully used, of course, so as not to scratch the glass. Then clean with a fold of a silk handkerchief over the end of a pointed stick, and wet in the mouth. In this way the slide is perfectly cleaned, and the ring or the finish is not affected in the least.

C. C. MERRIMAN.

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Oleomargarine.

Ed. Am. Jour. Microscopy—In the October JOURNAL OF MICROSCOPY, page 227 and on, in an article on "Oleomargarine," Mr. Michels criticizes with some considerable severity both my lack of knowledge and my statements.

The facts involved, whether of scientific or commercial interest, I leave for others to discuss; but I am sorry to say that Mr. Michels makes me say what I did not say, makes a wrong application of what I did say, and then, with such misunderstanding, proceeds with his criticism. To this I will attempt no answer here, as it is a matter which any of your readers may easily look up if they are interested in the subject.

I will only add that I hope that Mr. Michels is more careful and more accurate in his microscopical work than he has been with his quotations of my statement. Regarding what I *did say*, I still hold the opinion expressed.

WM. H. BREWER.

New Haven, Conn., Oct. 24, 1878.

NOTE BY THE EDITOR.

As copies of the daily papers may not be readily accessible to many of our readers, we quote from the *New York Times*, of June 27, 1878, that part of Prof. Brewer's letter which was published, and to which Mr. Michels refers. If any inaccuracy exists in the quotation, that is a matter for which Mr. Michels is not to blame:

"The second is from two letters by Prof. William H. Brewer, also of Yale College:

"'The idea that oleomargarine is more dangerous than butter because heated to only 120° Fahrenheit, is simply nonsense.'

"Prof. Brewer also gave the following written answers to the questions cited below:

"*First*—Do parasites infest the bovine race that could find their way into the human system through the use of oleomargarine as food?

"'To this I answer not that I have ever heard of; if such exist, science has not yet found them. The bovine race, like most other creatures, have parasites, but no species has yet been described which would be transmitted to man in that way.'

"*Second*—Can the microscope be relied on to distinguish between the butter fats, whether natural or artificial?

"'On this I cannot speak with certainty. My belief is that it cannot, so far as the mere fats are concerned, but that it would be an aid to chemistry in the hands of a skilful expert to distinguish between butter and other compounds of which such fats are ingredients.'

"*Third*—Is not oleomargarine, as made by the Mege patent, as wholesome and nutritious as cream butter?

"'So far as chemistry and common sense suggest, I see no reason why it should not be as wholesome and as nutritious as cream butter, and will so believe unless its actual use demonstrates to the contrary.'"

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Current Notes.

To Keep Pipes from Freezing.—The only certain preventive is the removal of the water, and it is worth while to make provision for turning off the water during very severe nights, letting it on during the day time. We must not forget, however, that merely shutting off the water will not answer; the water must be let out of the pipes. To do this a small tap or petcock should be placed just above the main stopcock, or the latter should be made with a vent which allows the water above it to flow out when it is turned off.

Lemon Tree Wood.—A writer in the "Gardener's Monthly" says that when in Rome, a few years ago, he was shown some work made out of the lemon tree that was considered almost as good as if made from box; and he makes the suggestion that a plantation of lemon trees for the wood, to say nothing of the fruit, would be profitable. The lemon tree is generally grown for fruit, but it would no doubt do well from a wood-growing point of view in less favorable climates. The lemon tree ought to do well at the South, and in many parts of California, and as boxwood is becoming quite scarce and expensive, the experiment is worth trying.

Fair of the American Institute.—The large building in which this Fair is held, seems to be better filled than ever this year, and many of the articles on exhibition are of unusual interest. One of the great attractions is the electric light, with which the building is illuminated, thus giving those who desire to see this new mode of lighting an opportunity to do so. One of the most interesting features of the Fair is the machinery in motion, and the various industries, the operations of which are carried on in the building. This makes the Fair one of the most efficient educational agencies in the city, and there is no place to which parents can take their children more profitably than to the American Institute Fair.

Diatoms.—Prof. P. T. Cleve, of Upsala, Sweden, has now ready for distribution his third series of diatoms, containing sixty slides. The first two series were exhibited at the Paris Exposition, and were awarded a silver medal. Under the title of "Diatoms from the West Indian Archipelago," Prof. Cleve has published descriptions and figures of many new forms of the Diatomaceæ. Among the Naviculæ, a subdivision has been made, admitting the genus Alloioneis, which was proposed by Schumann in the diatoms of the Hohen Tatra.

Packing Glass Ware.—Every one has this duty to perform occasionally, and it is well to know how it should be done. The safety of glass articles packed together in a box does not depend so much upon the quantity of packing material used, as upon the fact that no two pieces of glass come into actual contact. In packing plates, a single straw placed between two of them will prevent them from breaking each other. In packing bottles in a case, such as the collecting case of the microscopist, and the test case of the chemist, rubber rings slipped over each, will be found the best and handiest packing material. They have this great advantage that they do not give rise to dust.

Artificial Black Walnut.—A Belgian journal says a new process has been applied to the manufacture of artificial black walnut, by which ordinary wood has imparted to it the appearance of the most beautiful specimens of walnut, adapted to the very finest cabinet work. The wood, first thoroughly dried and warmed, is coated once or twice with a liquid composed of one part by weight of extract of walnut peel, dissolved in six parts of soft water, by heating it to boiling, and stirring. The wood thus treated is, when half dry, brushed with a solution of one part by weight of bichromate of potash in five parts of boiling water, and, after drying thoroughly, is rubbed and polished. The color is thus said to be fixed in the wood to a depth of one or two lines, and, in the case of red beech or alder, for instance, the walnut appearance is most perfect.

Prizes for Inventions.—Amongst the subjects for which the French Société d'Encouragement offers prizes, are the following: Small motor for domestic workshop; improvement in manufacture of flax and hemp; deadening of shocks caused by block hammers; heckling short textile fibres; instruments of automatic topography (3,000f.); file-cutting machine; improvement of steam engine; new alloy useful in the arts; artificial manufacture of graphite for crayons; manufacture of black diamonds; industrial use of oxygenated water; theory of steel, based on precise experiments (6,000f.); rendering tissues and wood uninflammable; sulphuric acid without arsenic, extracted from pyrites; chemical transformation, giving a useful natural product (4,000f.); cast steel or iron, improved by alloy with another metal (3,000f.); economical preparation and use of ozone; fixation of nitrogen of the air in nitrates, cyanides, or ammoniacal salts; artificial production of fatty bodies (4,000f.); disinfection of gas-purifying cases; permanent disinfection of water-closets (2,000f.); rapid desiccation of wood; means of preventing the adherence of soot in chimneys; food preservation; application of spectrum analysis in industry; small apparatus giving high temperatures; application of the endomose of liquids and of gases; destruction of centre of attack of phylloxera; utilization of land by fruit trees; distribution of pulverulent manures; employment of photography for typography. The awards are to be made at sundry dates between now and 1882.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Oct. 3, Vice-President Kinne in the chair.

The evening was an unusually brilliant one; the presence of Mr. Kinne's animated face, long absent, the attractive topic for discussion, and the number of members and visitors present, all contributing to that effect.

The current numbers of "American Naturalist," "Science Gossip," "Grevillea," and "Nature," were added to the library, and the cabinet was enriched by two generous donations of diatom slides, from Mr. William Norris and Father Bleasdale. Mr. Norris said of his slides, mounted by himself, that a number contained Navicula pinnularia and Campylodiscus clypeus, from Scotland, Bohemia, etc., and that the remainder, from a deposit found in Washington Territory, by Colonel Kinne, contained many forms similar to those of the well-known Kieselguhr earth.

These interesting slides led to a discussion concerning the manufacture of giant powder and like explosives, for which diatom earths are, after nitroglycerine, the chief ingredient, and it was regretted that the makers do not endeavor, by scientific experimenting, to so modify our abundant local earths that they may serve in place of the expensive importations from Germany.

Secretary Clark read extracts from a private letter from Rev. W. H. Dallinger, concerning that gentleman's admirable work amongst the lowest protozoa. The most recent result of that work, an almost fatal blow to spontaneous generation, appeared in the last AMERICAN JOURNAL OF MICROSCOPY, and concerning that work Mr. Dallinger says, in the letter alluded to: "There are three points that to my mind are of scientific force in the matter (spontaneous generation), viz.: First—The careful study of life histories, a tremendous labor, but a paying one. Second—The study of the behavior of the given organism under heat conditions of various kinds, without transference from the heated fluid or exposure to the air; and third, the study of the behavior of distributed germs, as described in my last paper but one before the Royal Microscopical Society, the nature of which we know, allowed to fall into artificial nutritive fluids, side by side with the debris of septic products supposed to be germs, so as to compare the behavior of the known with the unknown."

The topic of the evening, "The Microscope as an Instrument of Diagnosis," then being in order, Dr. S. M. Mouser read an introductory paper on "The Microscope in Medicine," which will be found in the next issue of this journal.

This led to a number of interesting remarks on diagnosis with the microscope, especially in the matter of blood corpuscles, after which the Society selected as a next topic, "The Microscope in Law," and then adjourned.

The regular meeting of the San Francisco Microscopical Society was held on Thursday evening, Oct. 17, at the Society's rooms, President Hyde in the chair.

Besides the usual periodicals, there were added to the library, by donation from the Australian Government, through Mr. W. A. Woodward, four magnificent folios upon the "Orchids of Australia," by Prof. Fitzgerald. These fine productions, filled with colored plates and of choice typography, are an honor to the scientific enterprise of far-away Australia, and greatly enrich the botanical shelves of the Society's library. The plates show the general and detailed structure of numerous species of these remarkable plants, the study of which has so often confirmed and exemplified the theory of natural selection.

The proceedings of the Belgian Microscopical Society are regularly received. The printed extracts of the most notable papers published on the Continent are a valuable feature of the welcome *brochure* that brings to San Francisco news o microscopic work in the distant Netherlands.

The chief event of the evening was a vigorous contest on the old battle field of spontaneous generation, initiated by the announcement of Haeckel's recent endorsement of the origin of life, *de novo*. Mr. Kinne stoutly maintained that the work of Tyndall and others simply consisted in removing every condition necessary to life (besides the mere exclusion of germs), and that the infusions remained sterile was a foregone conclusion. Mr. Hyde remarked that the results of Bastian and his fellow laborers had been proved unreliable, two vitiating factors—the endurance of continuous high heat by germs, and the contact of germ-bearing air—not having been fully provided against in their experiments. It was generally agreed that the theory of evolution includes the origin of life by natural processes from inorganic matter, and that such an origin is no more improbable than any other tenet of evolution.

But, "that creatures having quite specific structures are evolved in the course of a few hours, without antecedents calculated to determine their specific forms, is something immensely beyond that which evolution can achieve," to use the incisive language of Herbert Spencer. This great thinker can be still further quoted to the point. He says: "My disbelief extends not only to the alleged cases of 'spontaneous generation,' but to every case akin to them. The very conception of spontaneity is wholly incongruous with the conception of evolution."

Dr. Dennis, the delegate of the Society to the Microscopical Congress at Indianapolis, spoke of the interesting events of that meeting, especially the internal politics of the Congress, and the means by which the Congress resulted in a permanent and independent organization.

Dr. Mouser exhibited a slide of fibrous tissue, portions of a mass long retained in the ingesta of a patient.

The topic of "The Microscope in Medicine" was continued to the next meeting, and the Society then adjourned.

State Microscopical Society of Illinois.—The semi-annual and first meeting of the season of this society was held at the rooms of the Academy of Sciences, No. 263 Wabash Avenue, Chicago, on the evening of Oct. 25. The President, H. W. Fuller, Esq., in the chair, and B. W. Thomas acting as Secretary.

Prof. S. H. Peabody, having accepted a chair in the State Industrial University at Champaign, tendered his resignation as Secretary, which was reluctantly accepted, and Prof. E. B. Stuart was elected Secretary of the society to fill the vacancy.

About thirty members were present with ten microscopes, and many objects of interest and study. Among the visitors from out of the city, were Dr. Walter Kempster, Superintendent of the Northern Hospital for the Insane of Wisconsin, at Oshkosh; E. S. Fuller, Jamestown, N. Y.; Allen Y. Moore, Coldwater, Mich.; A. C. Palmer, Boston, Mass.; and others. Dr. Kempster made some very interesting statements relating to various examinations and experiments connected with the spinal cord, etc., showing results very different from what is generally understood among medical men. Mr. Bulloch made some remarks as to the desirability of a uniform objective screw of larger size than the London Society screw, as being a necessity in the construction of objectives of low power and high angles. Messrs. Summers and Atwood made brief statements of their vacation work.

The Hon. J. V. Lemoyne presented to the society some dozen volumes of Smithsonian Reports, Hayden's Geological and Geographical Surveys, etc. Several names were presented for membership, and altogether this was a very pleasant and profitable meeting.

After brief, but eloquent and encouraging remarks from the President, the meeting adjourned for one month.

Microscopical Section, Troy Scientific Association.—This section held its first meeting after the summer vacation on the evening of Oct. 7, at the residence of the Rev. A. B. Hervey. The attendance was large, and the meeting one of unusual interest. After a few preliminary remarks by the chairman, Dr. R. H. Ward, the following officers were elected for the ensuing year: Chairman, Dr. R. H. Ward; Vice-Chairman, Rev. A. B. Hervey; Secretary, C. E. Hanaman. The chairman then gave a very full account of the proceedings of the National Congress of Microscopists, held at Indianapolis in August last. The address was followed by a beautiful exhibition of mineral specimens; entire insects, prepared by a new process, by which their form is perfectly preserved, and also some fine rulings on glass by Mr. Fasoldt, of Albany, and Mr. Rodgers, of Cambridge, Mass. The meeting was an interesting one, and its results encouraging to the workers in microscopical science in that city.

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EXCHANGES.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Slides of moss peristome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

First-class injections and stainings of tongue, liver, kidney, bladder, intestine, stomach and brain of rabbit, and kidney of pig, in exchange for vegetable stainings, insects, etc. J. Eckstein, Jr., 136 Broadway, Cincinnati, O.

For exchange, for a microscope, a new lathe, with foot power, made by Broison & Kelly, Troy, N. Y.; cost $60. Address Dr. J. H. Converse, West Troy, N. Y.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.

Wanted, a good Möller's balsamed proof plate, in exchange for a Beck's microscope lamp. H. Watson, 31 Aborn street, Providence, R. I.

Leaves with stellate hairs, including the beautiful Croton eleuthera, from the Bahamas; also polyparies showing reproductive capsules, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

Slides of human lung in second stage of pneumonia, for other pathological specimens. F. W. Mercer, M. D., Southern Hospital, Anna, Ill.

Wanted, good gatherings of Pleurosigma angulatum, for diatoms, good slides; will give material or cash. Eugene Mauler, Travers, Switzerland.

Australian diatoms and other objects, unmounted, sent for varieties of insect pests in their stages; will exchange assorted local objects, unmounted, by direct correspondence. Sydney Gibbons, Melbourne, Victoria.

Sole skin and single and double stainings in exchange for other well mounted objects, anatomical preferred. John Walker, corner Eighth street and Twelfth avenue, Minneapolis, Minn.

Hamilton, Up. Held. and Carboniferous fossils; also eastern minerals, to exchange for fossils, minerals, shells, or Indian relics; lists of duplicates and desiderata sent upon application. B. H. Wright, Penn Yan, N. Y.

Sections of mauzanita, Calif. laurel, chapparal, Yerba lauta, mountain mahogany, cedar, etc.; copper and silver ores from Comstock lode, opaque; and rare chemicals for polariscope, for any good mounted objects. F. H. Engels, M. D., Virginia, Nev.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. III. NEW YORK, DECEMBER, 1878. No. 12.

What Can be Done with a Cheap Microscope.

So much has been published of late about the great superiority of the microscopes made by first-class opticians, and the comparative inferiority of the cheaper forms, that there is danger that the owners of the latter may get discouraged, and abandon altogether the use of the microscope, because they cannot afford a Zentmayer Centennial Stand and first-class objectives by Tolles or Spencer. Now, while we yield to none in our appreciation of the work of great microscope makers, and would earnestly advise every one to get as good an instrument as circumstances will allow, we think it may be well to give the owners of cheap instruments a word of advice and encouragement.

By a cheap microscope is meant one costing less than $30. For any sum less than this it is impossible to procure, in the present state of the market, an instrument possessing the qualities and appliances necessary for the performance of anything except the most elementary work, but then, on the other hand, it is astonishing what a wide range of ground is covered by the term "elementary work." If we take the cheapest form, say a common lens of a quarter-inch focus, we will be able to see a great deal that is utterly invisible to the unassisted eye; with a $20 microscope, judiciously selected, we can follow almost all the descriptions and explanations found in the ordinary text books. Let us take a middle ground, and consider the capabilities of such an instrument as may be had for from $10 to $20.

Such a microscope will not enable us to determine disputed points in histology, or to investigate the structure of test objects like the *Podura* scale, or *P. angulatum.* But it will show us clearly and well the various kinds of tissues, and even the cyclosis or so-called circulation of the sap in plants; it will show us the forms of the various kinds of pollen, and the number, situation and form of the stomata or breathing pores of plants; it will even show the more minute forms of plant life—those beautiful desmids and diatoms, which have always been the delight and the admiration of those who use the microscope, and although it will not enable us to see the markings on the more minute diatoms, it will show us their general forms and outlines, and reveal to a diligent and careful observer much of their life-history.

In animal physiology it will show us the peculiar forms of the blood of different animals, and it will show readily that most wonderful and beautiful of all microscopical objects, the circulation of the blood in the foot of the living frog. It will show us the structure of muscular fibre, and the peculiarities of the epithelium which lines the various internal organs. By it we can trace clearly the outlines and structure of many of the lower forms of animal life which would be otherwise invisible, and we will be thus enabled to assign them their proper place in the great system of classification. By it, too, may be studied the habits and life-history of the majority of the animalcules found in liquids.

That these statements are not exaggerated is shown by the fact that some of the most important discoveries have been made by means of microscopes far inferior to those that can now be had for $20. Indeed, much of the work of the great Ehrenberg was done with a microscope which to-day would not command $25. Therefore, let not the owners of cheap microscopes despair, for the field which is open to them is sufficient to occupy the longest life, and to employ the highest powers.—*Young Scientist.*

The Microscope in Medicine.

A Paper read by Dr. S. M. Mouser before the San Francisco Microscopical Society, Oct. 3, 1878.

THE term medicine has a broad signification, embracing anatomy, physiology, pathology, hygiene, materia medica, etc., etc. The foundation is anatomy, the study of which, within my recollection, was entirely macroscopic. A quarter of a century ago, the skeleton was carefully studied as to its articulations, protuberances for attachment of muscles, and grooves for muscles to play through; and, being arranged together, for the protection of the viscera from external violence. He who could describe the articulations, the points of attachment of the principle muscles, with a few of the foramina for the entrance of blood vessels to nourish the bone, was considered a pretty good student in that department. Dissections were diligently practiced for the purpose of determining the relations of soft parts to the bony system, and to each other. The circulating system was followed carefully as far as the naked eye could reach; and we were told that capillary vessels were a connecting link between the arteries and veins, which assertion we took on faith, never having the privilege of seeing them. Important organs of the body were studied with a great deal of interest, and with a great deal of difficulty, and suspected of being very elaborate and complicated. The skin was described as consisting of the epidermis and true skin, having beneath it "cellular tissue."

About the only thing we heard of microscopic anatomy during my student days was at the close of my second course, when our Professor of Anatomy, in his valedictory, told us it would be the last of his teaching for a while, as there was a new field being opened, the study of minute anatomy, and that he intended to turn pupil and avail himself of it, which he did. It was long after this, however, before anything like systematic teaching of histology was practiced in even the best medical colleges in this country. Now, no medical college is without it, and we have a large number of excellent works on the subject, with instruments and appliances for study, which leave no excuse for neglecting it, while it is considered as necessary to a complete medical course as the coarser anatomy was twenty-five or thirty years ago.

Physiology, so closely connected with histology, is receiving a great deal of attention; the microscope has been of great service in this department. When the beauties and complications of the human system are revealed to us, it is but natural that we should study the uses of it, and the results of its action. On the other hand, when we find results we look for the causes. We find so constantly one depending on the other, that they are necessarily studied together, giving an immense field for microscopic research.

Not many years ago, the principal use made of the microscope, by the average physician, was the examination of urine. Now, it is applied to the examination of nearly all the solids and fluids of the body, not excluding excrementitious matter; and as a means of diagnosis and prognosis, it has become absolutely indispensable.

Once familiar with the normal structure and healthy action of the human system, we are prepared to observe deviations from the healthy standard, which brings us to consider the subject of pathology, or a changed condition of structure, and, consequently, a different action. Here, again, the microscope has been of great use in distinguishing healthy from diseased tissues, and their products, and in determining the character of their changes. One of the most common uses of the instrument in this branch is the distinguishing benign and malignant disease, thus, in many cases, enabling us to decide whether a disease is curable or incurable, which is a matter of great importance to patients, as well as doctors.

Hygiene is also indebted to the microscope for many of the reforms of modern times. The preservation of health does not only depend upon our surroundings, but upon the adaptability of all substances taken into the stomach for the support of the body. In these days of fraud and adulteration, the microscope is a most efficient detective. Besides the frauds practiced by unscrupulous tradesmen, in mixing deleterious articles with many of the common necessaries of life, we have articles of diet not tampered with by dealers that are unfit for consumption. You are all familiar with the *trichina* in pork, for instance, which caused great suffering and death, and is easily detected, and avoidable.

The microscopic analysis of water is a very important hygienic precaution, and should always be resorted to in seeking water supplies.

In materia medica the instrument is useful for the detection of adulterations and impurities, as well as the identification of many articles used as remedies.

In forensic medicine it is often brought into requisition, and has frequently been the means of corroborating or refuting testimony, when nothing else could have done so. In criminal cases, it has sometimes been of great value. Not only can blood stains be made out, but the kind of blood often ascertained. Human blood, differing from that of many other animals, the difference can be proven by the microscope, and by no other known means. Again, it is a ready means of detecting some poisonous substances. It may be the means of clearing innocent persons from charges of crime, or bringing the guilty to justice. Some instances might be cited where the fate of human beings has been decided by it. And if any mistakes have occurred, it is probably not the fault of the instrument, but of the observer.

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The Use of the Microscope.

BY GEO. E. BLACKHAM, M. D., DUNKIRK, N. Y.

MR. L. R. PEET, of Baltimore, Md., to whom we are indebted (if I mistake not) for much valuable information in reference to the processes of double staining, has in the May number of the *News* an article under the above caption which I was right sorry to read. He divides those who purchase microscopes into groups of twenty or so, and asserts that nineteen out of every twenty get sick of their bargain in from three weeks to three months after their purchase. Those who continue to use the instrument he divides into four classes—only one of which uses the microscope as he thinks it should be used.

1st. Those who use it merely for pleasure.

2d. Those who are "smitten with the mechanical aspect of the thing." Of such a one he writes that "he is at once infected with an ambition to become an adept in the lore suggested. He wants to know * * the comparative merit of the work of celebrated makers, the prices each charges for his work, * * whose is rated least defective in point of chromatic aberration, whose in the matter of spherical ditto," etc.

In short, according to Mr. Peet, this absurd twentieth, this exceedingly improper fraction, having bought an instrument to the making of which has gone a high degree of mathematical and technical skill, becomes possessed of an insane desire to know all about it; nay, more, he may even go so far as to suggest an improvement or two.

Another goes farther; buys a Möller *Typen Platte*, and learns the names of the diatoms whose siliceous coverings are thereon embalmed; nay, he buys test objects and tries to resolve them, and either writes himself or reads what others write about angular aperture and definition and things; and, dread warning! "he becomes at last *plethoric* with microscopical technology, and that is his mental seeding."

This is truly dreadful; and Mr. Peet sadly exclaims: "The number of the above sketched is too large." And they "sneer at him who merely seeks to make the instrument a help to see." Too bad, too bad. How do the ungodly flourish! These miserables, who have squandered their time in riotous living, with catalogues and books on optics, and tables of logarithms and *Typen Plattes*, and what not—they "sneer at him who merely seeks to make the instrument a help to see;" who regards it, so to speak, as a pair of brass-mounted spectacles; and knowing that this latter and eminently commendable person has never bothered *his* head over abstruse questions of angular aperture and chromatic and spherical aberration and definition of the edges of things, they say, "Oh, he does not know anything about the microscope; I would not give a snap of my finger for what he might say about it." Alas! too true. I have seen such men myself. Obstinate are they, refusing to believe that a man who has never given any time to the study of this marvelous instrument can be competent to form a valuable opinion about it.

Let us turn from the contemplation of this sad spectacle of human depravity to the more agreeable view presented by the *fourth twentieth*, the *one* man out of fourscore, whom Mr. Peet "thinks uses the microscope as it should be used," but whom with undue modesty he protests is not himself. What has he done? "He has made sure that his higher powers enable him to see things as small as the markings of *Amphipleura pellucida*, and that his lower powers have clean, level fields." And "then he has learned to make plain slides, and has gone at it with abiding zeal;" and he wants to know about "the denizens of the stagnant pool, about the structure of insects and their embryos, and that of plants." The three months that operated so disastrously on the nineteen he has made use of to become accustomed to handling this new and astonishing aid to sight, and to *learn the art of mounting objects.* He has then begun to gratify his impatient desire to *know*, a most virtuous and commendable course truly, and in pleasing contrast to

> "The ways that are dark,
> And the tricks that are vain,"

of those who have squandered their time in "contemplation of the ingenuity evinced in the structure" of the microscope, or in seeking out the true inwardness of spherical or chromatic aberration, or in striving to resolve the catalogue lists of tests. And yet one wonders *how* "he has made sure that his higher powers enable him to see things as small as the markings on *Amphipleuru pellucida*, or that his lower powers have clean, level fields," unless he, too, has given some attention to the catalogue lists of tests and spherical aberration, and the definition of the edges of things.

But seriously, is it not time to abandon this idea so persistently set forth that it is in the study of "natural history only that the microscope can be legitimately used?" Is it not time to admit that the microscope has gotten beyond the spectacle stage, and that to use it intelligently one must look *into* it as well as through it—must study the principles upon which it is constructed, must know something of chromatic aberration and of spherical ditto, with their causes and the effects they have upon the definition of things? Have not the labors of those who have given attention to these things been to the advantage of those who paid no attention to them, and whose microscopes have been to them "only helps to see?" And even if it were not so, is not the science of optics as legitimate a field of intellectual research as biology? And if a man chooses to use his microscope to study out its own anatomy and physiology, so to speak. instead of "the structure of insects and their embryos," who shall say him nay?

And why should he not "reduce to elements the *outside* morphology of fossil diatoms" as well as the *inside* morphology of the "denizens of the stagnant pool?" And even the man who uses his microscope for entertainment only, and who never makes it teach him anything (if such a man there be), has he not a right to do what he will with his own? Yes, truly; and let us rejoice that he chooses so rational a means of entertainment.

In short, is it not time for certain specialists to give up the narrow view that *their* specialty is the *only* legitimate study in the world, and to remember that but for the studies and labors of those who have given their attention to the optical and mechanical structure of the instrument, and the use of test objects, etc., the instrument he uses to-day would never have come into existence; and to admit that this much contemned class *may* be doing *nearly* as much for microscopical science as those who devote their time to the production of mounted sections, "just too lovely for anything," and which often rival Joseph's coat, not only in the variety and brilliancy of their dyes, but in their value as objects for scientific study.—*Cincinnati Medical News.*

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—By the use of the electric light, a foot-ball match, witnessed by 30,000 persons, was played on the night of Oct. 14, at Sheffield, England.

The Microscopical Examination of Yeast Popularly Explained.

IN my necessarily brief essay on this subject—a subject which is becoming of vast interest to even practical brewers—I am anxious to steer clear of all complexity of expression, and while not entering into much detail, to so sketch microscopical working as to render it possible for such of my readers as at present derive little practical benefit from the existence of the microscope as a working instrument for daily use—to carry out without further tuition a reliable examination of their yeast and beer.

First of all, then, let me say a few words about the instrument itself. For a brewer's purpose everything depends upon the quality of the "objectives," or "object glasses," and corresponding "eye-pieces." These should be of the very best make, even if such refined workmanship makes them costly, while the microscope should be fitted with a very accurate revolving stage, so that varying fields of view may be seen at will. A number of costly extras are in my opinion useless, and so long as the objectives, eye-pieces and stage are perfect, little attention need be paid to the mere stand or to the other fittings attached to these expensive instruments. Everything, in short, must be sacrificed to the essential requirements, and if we limit the cost price of the microscope as a whole, let no limit be placed upon the sum expended in obtaining but a single object glass and its corresponding eye-piece. If we *must* economize, let it be in feeling satisfied with a monocular glass with a 1-6th objective, which answers all practical purposes, and which, with its deeper eye-piece, will give an enlargement of some 400 diameters.

The instrument once procured, we can easily settle the question of light. A clear diffused natural light is not always to be had, or perhaps that would prove best, so we may with advantage fall back upon gas as the best artificial illuminating medium.

The next step is to arrange the instrument for use, that is, to focus it, to carefully see that the eye-pieces and lenses are free from specks of dust and dirt, and that a bright light is reflected upon the field which is to become the background of the yeast cells. All the lenses unscrew, but so delicate is their arrangement, that some little experience is required before the operator can succeed in so polishing and replacing them when unscrewed as to escape interference with magnifying power. This is knowledge that must be gained by practice, for however careful we may be in keeping our instrument covered with a glass shade when not in use, dust is sure to settle on the eye-pieces and lenses, and appear as impurities in our yeast, unless care is taken to insure the absolute cleanliness of them before we consider our instrument in working order. For the purpose of polishing, a piece of soft wash leather answers admirably, and we can easily determine the success of our manipulation in this direction by viewing the field with the microscope in position, and the illuminating power at its greatest intensity before placing our specimen on the stage.

We next come, of course, to the preparation of the sample yeast, and I do not go too far in saying that this is the point at which the greater number of operators fail, the greatest care being necessary, not only in making the mixture, but in placing exactly the proper quantity of it on the examination slide. A small beaker and short glass rod should be taken, well washed and swilled out once or twice with distilled water. Again filling the beaker, we take the glass rod and mix in just sufficient of the yeast we are examining to make the water look opaque (we can soon fix a standard of turbidity for ourselves), a drop or so of pure glycerine may be added, which serves to prevent distortion of yeast cells, and any froth on the surface may be removed by causing the beaker to overflow with the distilled water, which, of course, must be of absolute purity. The glass slide and covering slip we employ must be polished perfectly bright with our wash leather, and then all is ready for our critical examination of that yeast which in a state of purity serves us so well, but impure, creates for us difficulties and troubles that end always in the same final result—the rapid deterioration of our produce. Holding our glass slide in the left hand between thumb and first finger, we dip with our right hand the small glass rod mentioned above, into our very dilute yeast water, and withdraw sufficient to give a small bead of fluid on the centre of the slide glass, the appearance of this bead, indeed, to the naked eye, telling us if the degree of fluidity is correct; the bead, in short, should appear almost as if it were so much clear water. Taking up a pair of minute pincers, we by their aid bring the covering slip obliquely down on one side of the fluid bead, allowing it to sink slowly on it, so as to drive out any excess of fluid (and, what is of more importance, air) by the time it has flattened on the slide itself, finally removing any moisture from the edges of round covering slip, by carefully applying a fragment of blotting paper. I have explained this in detail, since all care should be taken in securing a good field free from *excess* of cell life, *motionless*, and unspoilt by foreign impurities and the presence of air bubbles, and these essential points will be arrived at by giving due attention to the rules sketched above. Placing our slide on the revolving stage, we carefully focus our instrument as nearly as we can with the coarse movement, taking care that we do not in our hurry bring down the objective lens on the covering slip itself, since with all the high powers wherein the focal distance is very slight by comparison, this is easily done, so close has the lens to be to the object we wish to view, while if pressure be once placed by such means on the covering slip, the field becomes entirely spoilt. Directly a dim outline of field of yeast cells comes in view, we procure perfect focus by the use of the fine movement, working this one way and the other with a finger of either hand until the view of our yeast is perfect. What constitutes this perfection? Well, in the case of the torulæ they should appear perfectly clear in outline, without any dark ring indicating that outline, and much the same rule applies to all the ferments; mere specks of black on the field, for instance, become visibly organized when brought into perfect focus, and many a fatal sign becomes apparent when such focal attainment is arrived at.

While in a good yeast a single focal distance suffices, we have in the examination of secondary qualities to vary that distance according to the ferments we are looking for; but a little practice will soon enable our readers to satisfy themselves on this point, while it is easy to see that we can vary the field with rapidity and ease without any alteration of focal distance being necessary, bringing under the searching view of our lens those portions of the field which are the more fluid, and therefore the more likely to be contaminated with impurities, since the ferments of disease are, as a general rule, fairly lively and of comparatively minute size, by these reasons tending to drift away in the fluid to its natural outlet, the edge of the circular covering slip.

Let me now for a very brief moment turn to a simple description of our ideas respecting a yeast that can be regarded as fit for use in practical brewing, and I think a very clear knowledge on the point can be acquired, even by youthful students, by adopting the following plan of preliminary study: Let my readers mash some crushed malt in cold water in a sterilized tube, inserting a cotton-wool plug in mouth, standing tube in beaker of water at 150° or so for several hours, allowing it to remain afterwards in some warm place for several days. If they now daily examine a single drop of the fluid portions of mash so arrived at, they will gain a very clear insight of the various diseased ferments that our yeast is heir to—lactic acid ferments in varying stages of development; filamentary rods of acid and putrefactive influence; the small spheres, generally forming by a combination of two the figure eight (8), and denominated in popular microscopical parlance No. VII, will appear with wonderful rapidity, according to the character of the malt, and what we brewers have to learn is *how* to prevent such forms of life appearing in our working yeast. With the atmosphere at high temperature, and overladen with vital impurities, with contaminated water, and a faulty system, it is difficult indeed to preserve the purity of yeast. The constant struggle, nevertheless, must be in this direction, if we wish to attain success; and if in our fields of yeast we see distinct evidence of active diseased life, no time must be lost in stamping it out with such means as I myself am always, in my essays, enlarging upon, or in planting a fresh and good supply from some other source. It is impossible perhaps to prevent the presence of a few lactic acid ferments as long as the tendency of the chief material we employ is to allow the formation of lactic acid; but filamentary rods of either kind—well may they be called "subtile" in their influence—are of grave import, while any combination of these with those small spherical cells in twos and threes, is not only of grave, but of fatal influence, necessitating immediate action on the part of the brewer.

If it be important to see that our yeast is free from actual impurities such as these, it is no less important to critically examine the cells of vinous ferment, since they can deteriorate and be influential to disaster, without the presence of those we specially called diseased. Now, a critical examination of yeast can only be made when the field of view is not overcrowded with cells, and thirty cells are certainly sufficient, while the state of dilution to give such a quantity will soon make itself apparent after a little experience.

For this purpose, too, a 1-6th inch object glass with deep eye-piece seems to me better than those highly expensive powers with short focal distance, for the object in need is not so much to get enlargement as clearness and stability of field of view, objects the more easily attained with low rather than with the higher powers.

Now, what are the chief characteristics of a healthy torula? First and foremost I should say perfect regularity of size, as evidenced by all the cells in the field being in focus at the same time; for, practically, difference in size of matured cells means a very insidious action of weakness. Next we come to the microscopical appearance of the interior. In young yeasts we see what may be called a plasmatic sack floating about (but generally in the centre) in the fluid contents, while, as cells develop, nuclei become more and more distinct, and it is in watching this development that we can determine the point at which the yeast has come to maturity, and turned the point towards actual deterioration. There is, indeed, no quality of yeast more fatal to success in practical brewing than that grouped under the term *weak*, and this is evidenced by the nuclei becoming too numerous, until a granulated look takes the place of the clear and pleasing view of a cell, with its plasmatic bag, or developed, yet not excessive nuclei.

This condition of yeast, this so-called weakness, is brought about under the influence of a species of starvation, when we are not submitting the description of food upon which such yeast can grow and reproduce itself in perfection; and if any of my readers wish for practical experience of this granulated look, they have only to place some yeast in a pure sugar solution, and microscopically examine the deposit after a few days interval. Let them notice it well, and guard most intently lest by the use of sugar, of whatever species, in excess, they promote, unknown to themselves, a like appearance in their working store.

I must refer to one more faulty indication, and then I have done. If we sometimes see a semi-circular ring in the interior of certain cells, touching by its two extremities the boundary of the cell itself, we may be sure that it is the index of faulty spontaneous clarification. It is an index only. I cannot say how it comes to be one, but the abnormal condition of our yeast is, no doubt, indicated to the microscopical observer by such slight alterations in the arrangement of its structural form.

It is only by lengthy practice that we can arrive at perfection in microscopical examination, but a little trouble will soon enable the worker to determine the comparative purity of the yeast store, and render the instrument of even more extended use in the *selection* of yeast for pitching purposes, and for sorting out such beers as are capable of withstanding lengthy storage.

I have concerned myself in this paper with the most fatal ferments of disease, and have deferred all reference to certain fungoid growths that are less influential in promoting insidious change. The paper is one for popular reading, necessarily crude, limited to a certain space, and yet not incapable of giving my readers, I hope, some little instruction in a branch of knowledge that as yet they are not very proficient in. Though short, I might have made it dry in the extreme by historical references, and the wording of scientific nature; let me trust that in avoiding this I have not also missed the mark and written a paper of little practical worth to those who asked for its production.—*London Brewer's Journal.*

Outlines of a Process for the Examination of Urine for Medical Purposes.

ARRANGED BY R. HITCHCOCK.

IN collecting a sample of urine, the greatest care should be taken to have the receiving vessel perfectly clean. Extraneous matter may frequently mislead the novice, or at least serve to puzzle him. The physician should also try to avoid deception on the part of patient and attendants. It sometimes happens that for some inscrutable reason foreign matters have been added to samples of urine by patients or others. Such additions, however, are not liable to cause any confusion, for they are not of a character calculated to deceive. The author once received a specimen, however, in which the microscope indicated amorphous urates in considerable quantity. A little closer examination, however, convinced him that some vegetable powder had been added for deception, and he declined to make any report on that sample. An addition of this character is well calculated to deceive, and care should be taken to avoid hasty and superficial examination.

The proper time to collect the sample is in the morning, after a good night's rest. It should reach the microscopist's hands as soon as possible, so that no appreciable change may take place and alter its reactions or appearance. After evacuation, urine soon commences to change its character; what is called acid fermentation begins, and the fluid becomes decidedly acid. After a time this gives place to an alkaline fermentation. In some cases of disease, the alkaline fermentation sets in almost immediately after the urine is passed.

In this article, the design is to assist not only the student, but the practitioner who desires brief memoranda to help him systematize the work with which he is already familiar.

The plan varies from what is commonly found in the text books, in that the author commences with the microscopical examination as is the most natural in actual practice, and introduces the chemical tests as supplementary just as they are liable to follow in practice.

In one sense the arrangement is not systematic, but is thought to be useful. In the absence of figures, and with limited space, a complete treatise is not possible.

The urine must be tested with litmus paper as soon after voiding as possible. If the blue color of the paper when moistened in the sample turns to red, the reaction is acid. If the red paper is changed to blue, the urine is alkaline.

The specific gravity should now be taken by means of the urinometer. In health it varies between 1003 and 1030. About four ounces of the sample must now be placed in a conical glass and allowed to stand in a quiet place, covered to keep out dust, not longer than twelve hours. In every sample thus treated may be found epithelium and mucus in very small quantity.

If an appreciable deposit is seen at the bottom of the glass, the clear fluid is poured off into a clean vessel, and by means of a dipping tube 5 inches long by 1-16th of an inch internal diameter, a drop of the deposit is placed upon the slides of a microscope and examined with an amplification of 200 to 250.

We may have three kinds of deposits as follows:

1. *Light, flocculent, white,* (indicating mucus), *tube casts, spermatozoa and fungi* (in rare cases).

Mucus is indicated by a stringy deposit not mixing readily with the fluid, and showing under the microscope circular granular corpuscles (leucocytes) in the almost invisible mucin.

Tube casts will not be recognized at once by the novice, unless large and granular. The hyalin casts are very clear and transparent, sometimes requiring the light to be thrown slightly out of its direct course to exhibit them well. If tube casts are suspected or found, the clear fluid should be boiled in a test tube, when albumen will probably be found as a flocculent or dense preciptate. Confirm its presence by adding a few drops of nitric acid to another portion which will cause another flocculent or curdy precipitate, if albumen is present. If albumen is found, tube casts should be searched for carefully.

Spermatozoa must be looked for carefully. They appear like minute tadpoles with greatly elongated tails.

The fungi may be the true torulae (yeast plant), or plants closely resembling this, but smaller.

2. *Heavy, Thick and Colored Deposits.*—These indicate the presence of pus, phosphates and urates.

Pus under the microscope resembles mucus. When pus is present, the supernatent fluid contains albumen. This is not the case with mucus. Pus mixes readily with the fluid on agitation. With solution of potash, pus becomes gelatinous and thick, resembling mucus.

The phosphates generally found in this deposit are triple phosphates, so called. They occur finely crystallized in the form of prisms of considerable size of a clear white color. Their large size usually distinguishes them from other deposits, with the exception of uric acid, and the color of large uric acid crystals is yellow or darker verging upon red. Phosphates dissolve readily in acetic acid.

Urates.—These urates of the alkalies occur most commonly as amorphous deposits, showing merely a granular appearance under even very high powers. At times, however, they are found as spherical balls, appearing yellowish or black, often covered with projecting crystals like spines. When such an amorphous deposit is seen, some of the urine containing the deposit is placed in a test tube and heated not quite to boiling. The urates then dissolve entirely. The material upon the slide may be treated with a drop of hydrochloric acid and set aside for an hour. If now examined by the microscope fine crystals of uric acid will be seen if urates were present.

3. *Granular or Crystalline Deposits. Blood, Oxalate of Lime, Uric Acid, and other compounds.*

Blood.—The red corpuscles of blood are distinguished from leucocytes by their clear surfaces, inferior size, and, unless expanded by endosmose, depressed centres which appear darker than the edges when in proper focus. Such urine always has an albuminous reaction.

Oxalate of Lime.—This occurs in crystals which are usually very small. They are octohedral, and appear like four-sided pyramids looked at from the apex. These crystals frequently form in urine on standing, when at first not to be found. They originate from decompositions which take place, and for this reason only rather fresh urine should be used in this examination.

Uric Acid.—This deposit is universally found in acid urine. It occurs in crystals of almost endless form and size, many times so large that they can be recognized with the naked eye. Their color is quite characteristic, appearing yellowish to red under the microscope. Caustic potash or ammonia dissolves these crystals.

Besides the deposits mentioned above are others more uncommon, as the stellate phosphate of lime, oxalate of lime in the form of dumb-bells, and cystine in hexagonal plates.

Urea, when present in excess is indicated by the high specific gravity. To test for this ingredient the urine is mixed with an equal volume of concentrated nitric acid, and allowed to stand a short time in a cool place. It is well to concentrate first slightly. If urea is in excess, the characteristic crystals of nitrate of urea will be seen under the microscope. Oxalic acid may be used in place of nitric.

Chemical Tests.—Besides those mentioned above in connection with microscopical examinations for urates, albumen or urea, there are a few which have a strictly chemical application. Among these we give tests for:

Sugar.—Specific gravity usually over 1,025, when sugar is present. If to urine containing sugar a solution made up as below is added, and the whole boiled, a bright red precipitate is formed:

Cryst. sulphate of copper, 90 grains.
Neut. tartrate potassium, 350 grains.
Caustic soda sol. sp. gr., 1.12, 3 fl. oz.
Water, to make, 8 fl. oz.

Bile.—This is generally indicated by color and taste. Pettenkofer's test is the best. Albumen, if present, should first be removed by boiling and filtering. If biliary matter is in small quantity, evaporate somewhat. Dissolve a grain or two of sugar in the urine, and add slowly strong sulphuric acid, keeping the temperature low, if necessary by means of cold water on the outside of the test tube. After about two-thirds of its volume of the acid has been added, a violet red color appears at once, or before long, when biliary matter is present. If the color does not develop rapidly enough, heat very gently at last.

Fatty and chylous matter are also found in urine. Fat globules are often introduced by the instruments used by the surgeon in certain cases.

On Biotite as a Pseudomorph after Olivine.

Paper read by Prof. A. A. Julien before the New York Microscopical Society.

THE extent of the distribution of the mineral chrysolite has been fully understood only within a comparatively short period. In the transparent and sometimes crystallized form it was imported by the ancients into Europe from the Levant and from an island in the Red Sea, and used as a yellowish-green gem, under the name of topazion. In the more common variety, translucent to opaque, called olivine, it has been found more generally in basalt, lavas, gabbros, and diabase, as rounded grains or nodules, sometimes several inches in diameter, and even weighing thirty pounds, especially on the Rhine, in Sweden, and the Sandwich Islands; or in beds, as in Norway, New Zealand, etc., and with still less prominence in this country, in Vermont, Canada, North Carolina, etc. Aside from its rare isolation in bedded masses, called olivine rock, or dunyte, or in peculiar predominance in certain rocks called lherzolyte and picryte, the mineral has been usually treated as an insignificant accessory in the constitution of rock masses, and as a natural consequence little importance has been assigned to its occurrence.

The recent application of the microscope, however, to the study of rocks has in this field of lithology, as in so many others, effected a revolution in the views of investigators. So that, for one of the most extensive groups of rocks—that of the varieties of diabase, porphyryte, melaphyre, andesyte and basalt, whose relationship has always presented a troublesome problem, a scheme of classification has been presented by a high authority* within the last year, which depends in part upon the presence or absence of olivine. Any observations, therefore, which bear upon the forms of alteration of this mineral may now possess a special interest.

No kind of lithological investigation is more fascinating than that which deals with the transformations through which many, perhaps most minerals, pass, under various subterranean conditions; those which prevail within that layer of the earth's crust which is subjected to atmospheric influences, particularly water at the ordinary temperature, saturated with air and carbonic acid, and containing alkaline carbonates, chlorides, etc., and also those which prevail throughout a certain lower stratum, with higher temperature and a varying content of certain salts, such as the alkaline silicates. New substances have thus been produced, sometimes by the removal in part or altogether of the original material, and by the partial or complete substitution of some other. When, as often happens, the form of the original mineral, perhaps a crystal, has escaped obliteration, or even injury, by the slow progress of this change, the term "pseudomorph" is applied to the result. In a mineral this often presents a puzzle to the crystallographer, and occasionally, even in a rock, retains a texture or stratification, or both, which may be entirely foreign to the last remaining material. The microscopic structure of pseudomorphs is often very interesting, and may reveal all the stages of the process to which they owe their existence.

Only two such forms of alteration have been hitherto reported in regard to olivine. In the one, by its absorption of oxygen from ordinary aerated waters, and by the conversion of its ferrous into ferric-oxide, it assumes a reddish-brown color, iridescent lustre, and micaceous structure, and finally passes into an ochreous condition. In the other, by the action of carbonated waters, the iron and magnesia are in part *removed*, with a pseudomorphous remnant, consisting sometimes of serpentine and sometimes of other magnesian species—or wholly removed, leaving a silioeous residue, ordinarily some variety of chert. The passage into serpentine is by far the most common, and indeed is so very nearly universal though often incomplete, that lithologists have long been generally inclined to assign the genesis of nearly all serpentine to the alteration of olivine. Basalt, diabase, and their associates already alluded to, commonly contain olivine in greater or less abundance in the form of microscopic granules which almost always exhibit this alteration in thin sections. The contour of the grain is generally marked by a delicately laminated envelope of yellowish-green serpentine, and the same mineral traverses the grain in thin veins, often more or less ochreous, which have occupied the irregular fissures which cross the fragile olivine grain from side to side. At a later stage of the alteration, each fragment of the original mineral is converted into a concretionary mass of serpentine, encrusting a nucleus of unaltered olivine. Or finally, the latter mineral has entirely disappeared, and a true serpentine-pseudomorph is the result. Many or all of these stages of alteration into serpentine may be often seen in the same slide, so that peculiar interest has been attached to olivine, as presenting in thin section a typical and easily observed exhibition of pseudomorphous change.

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*Mikroskopische Physiographie der massigen Gesteine. H. Rosenbusch.

However, in a rock recently studied,* I have observed the passage of olivine into biotite and its viridite ally, associated with more or less talc, magnetite and ferric oxide. Near Bad River Falls, in Ashland County, Wisconsin, occurs a chrysolitic diabase, which is in part very coarse, with its predominating constituent, Labradorite feldspar, in facets sometimes an inch or more across. The rock is also rich in brownish augite, which displays, by fine lamellation and a common but feeble dichroism,† a transition into diallage which may perhaps be so general as to entitle the rock to the name of gabbro. The accessory minerals, which are observed in the thin section to be mostly gathered in the vicinity of the augite, consist of the greenish chloritic substance which is styled viridite by lithologists: opaque and black grains of magnetite: olivine, in crystalline colorless grains, which sometimes present a definite hexagonal contour: talc, in grayish-white scales and crusts upon the olivine and augite: biotite in yellowish-brown scales, generally adhering either to the olivine or augite: and ferric oxide, in ochreous films, in many interstices. The olivine is sometimes attached to the augite, and sometimes isolated in the midst of the feldspar, and its crystallization has evidently preceded that of the other minerals in the formation of the rock out of the original magma. In the most interesting instances, the olivine grains are presented as partial or complete pseudomorphs, retaining the original hexagonal cross-section. In these there sometimes remains a nucleus of unaltered olivine, traversed by its characteristic irregular fissures, which are generally occupied by veins of viridite, associated with more or less magnetite granules and ochre films. On one or more sides the olivine is replaced by the biotite, which is readily distinguished by its micaceous lamination and its dichroism, especially powerful on the cross-section of its laminæ. The outline of the crystal is occupied by a thin crust of talc, sometimes colorless and crystal clear, with a very delicately thin lamination perpendicular to the original outline of the grain. In some cases two or more alternations of thin crusts of biotite and talc may be seen to envelop the remnant of the olivine nucleus. By the expansive force of the crystallizing biotite, the talc crust is often ruptured at several points around the grain, through which the biotite laminæ shoot out, and the adjacent talc scales become wavy, bent and separated, and even carried out into the cleavage planes of the surrounding feldspar.

The chemical changes, which are represented by all these microscopic forms of alteration of olivine, may be summarized in the ensuing table of percentage composition:

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*Report on Geology of Wisconsin, Vol. III.

†The property of certain minerals which display change of color on rotation of the section above the polarizing prism alone, the analyzer having been removed.

	Olivine.	Serpentine.	Talc.	Biotite.
Silica..........	36.48	40.44	62	36 44
Ferrous Oxide.	6.29	1.10	..	....
Ferric Oxide...	....	....	..	4.26
Magnesia......	32.50	34.43	33	9.25
Water.........	...	9.16	5	0.4
Alumina	....	....	..	11 19
Potassa........	....	....	..	1.11

In the ordinary conversion of olivine into serpentine, in common rocks, there is shown above, a partial removal of the ferrous oxide from the former mineral, and its replacement by water. It is probable that the percolating solution, which has effected these changes, has possessed a certain elevated temperature whose retention permitted the saturation of the solution by magnesian silicates, and whose loss occasioned the re-deposition of the latter, in the form of a large variety of magnesian minerals, in the veins of contraction throughout the serpentine mass.

But in the Wisconsin rock there are presented two agencies of attack upon the olivine, both at low temperatures. First, simple atmospheric waters have slowly acted upon the grain along its latent fissures, and especially over its outer face; the ferrous oxide has been separated from the surface, oxidized, deposited within the fissures, and partially removed as carbonate; the remaining constituents have been gradually recrystallized as a hydrated magnesian silicate in the form of the talc shell; the result has been a concentration of silica in the composition of this crust; and it resembles a "pseudomorph by incrustation." Ultimately, the interior of this shell has been permeated by a solution of alumina in alkaline carbonates, derived from the gradual decomposition of the surrounding feldspars; a part of the magnesia has been exchanged for alumina and potassa, the iron has been further oxidized, become insoluble in the new menstruum, and has not been removed; and the residuary constituents have re-combined as biotite, in expanding plates which have at last thrust themselves through the first envelope.

It is possible that this new result of the alteration of olivine may yet assume some petrographical importance in other ways than those already suggested. For instance, though olivine is found as an accessory mineral in the diabase of some of the Triassic dykes along the Appalachian Belt, in others it seems to be entirely wanting. It occurs in the diabase of some of these dykes, both in New Jersey and Connecticut; but in the extensive Palisade range of the Hudson River Valley, and in the corresponding dykes of Virginia and North Carolina, its occurrence has hardly yet been noted.

And yet thin sections of the diabase of these very dykes last mentioned sometimes are exceedingly rich in scattered microscopic scales of biotite, which may perhaps represent altered granules of olivine.

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Recent Progress in the Study of the Lower Order of Cryptogams.

IN the recent Anniversary Address by the President, Sir Joseph Hooker, C. B. K. C. S. I., before the Royal Society, occurs the following passage which will prove of special interest to our readers. The address in full may be found in recent issues of *Nature:*

In morphological botany attention has been especially directed of late to the complete life-history of the lower order of cryptogams, since this is seen to be more and more an indispensable preliminary to any attempt at their correct classification.

The remarkable theory of Schwendener, now ten years old, astonished botanists by boldly sweeping away the claims to autonomous recognition of a whole group of highly characteristic organisms—the lichens—and by affirming that these consist of ascomycetal fungi united in a commensal existence with algæ. The controversial literature and renewed investigations which this theory has given rise to, is now very considerable. But the advocates of the Schwendenerian view have gradually won their ground, and the success which has attended the experiments of Stahl in taking up the challenge of Schwendener's opponents, and manufacturing such lichens as *Endocarpon* and *Thelidium*, by the juxtaposition of the appropriate algæ and fungi, may almost be regarded as deciding the question. Sachs, in the last edition of of his "Lehrbuch," has carried out completely the principle of classification of algæ, first suggested by Cohn, and has proposed one for the remaining thallophytes, which disregards their division into fungi and algæ. He looks upon the former as standing in the same relation to the latter as the so-called saprophytes (*e. g. Neottia*) do to ordinary green flowering plants.

This view has especial interest with regard to the minute organisms known as *Bacteria*, a knowledge of the life-history of which is of the greatest importance, having regard to the changes which they effect in all lifeless, and, probably, in all living matter prone to decomposition. This affords a morphological argument (as far as it goes) against the doctrine of spontaneous generation, since it seems extremely probable that just as yeast may be a degraded form of some higher fungus, *Bacteria* may be degraded allies of the *Oscillatoriæ*, which have adopted a purely saprophytal mode of existence.

Your *Proceedings* for the present year contain several important contributions to our knowledge of the lowest forms of life. The Rev. W. H. Dallinger, continuing those researches which his skill in using the highest microscopic powers, and his ingenuity in devising experimental methods have rendered so fruitful, has adduced evidence which seems to leave no doubt that the spores or germs of the monad which he has described, differ in a remarkable manner from the young or adult monads in their power of resisting heated fluids. The young and adult monads, in fact, were always killed by five minutes' exposure to a temperature of 142° F. (61° C.), while the spores germinated after being subjected to a temperature of 10° above the boiling point of water (222° F.)

Two years ago, Cohn and Koch observed the development of spores within the rods of *Bacillus subtilis* and *B. anthracis*. These observations have been confirmed, with important additions, in these two species by Mr. Ewart, and have been extended to the *Bacillus* of the infectious pneumo-enteritis of the pig, by Dr. Klein; and to *Spirillum* by Messrs. Geddes and Ewart; and thus a very important step has been made towards the completion of our knowledge of the life-history of these minute but important organisms. Dr. Klein has shown that the infectious pneumo-enteritis, or typhoid fever of the pig, is, like splenic fever, due to a *Bacillus*. Having succeeded in cultivating this *Bacillus* in such a manner as to raise crops free from all other organisms, Dr. Klein inoculated healthy pigs with the fluid containing the *Bacilli*, and found that the disease in due time arose and followed its ordinary course. It is now, therefore, distinctly proved that two diseases of the higher animals, namely, "splenic fever" and "infectious pneumo-enteritis," are generated by a *contagium vivum*.

Finally, Messrs. Downes and Blunt have commenced an inquiry into the influence of light upon *Bacteria* and other *Fungi*, which promises to yield results of great interest, the general tendency of these investigations leaning towards the conclusion that exposure to strong solar light checks and even arrests the development of such organisms.

The practical utility of investigations relating to *Bacillus* organisms, as affording to the pathologist a valuable means of associating by community of origin, various diseases of apparently different character, is exemplified in the "Loodiana fever," which has been so fatal to horses in the East. The dried blood of horses that had died of this disease in India has been recently sent to the Brown Institution, and there afforded seed from which a crop of *Bacillus anthracis* has been grown, which justified its distant pathological origin by reproducing the disease in other animals. Other equally interesting experiments have been made at the same institution, showing that the "grains" which are so largely used as food for cattle, afford a soil which is peculiarly favorable for the development and growth of the spore filaments of *Bacillus;* and that by such "grains," when infected, the anthrax fever can be produced at will, under conditions so simple that they must often arise accidentally. The bearing of this fact on a recent instance in which anthrax suddenly broke out in a previously uninfected district, destroying a large number of animals, all of which had been fed with grains obtained from a particular brewery, need scarcely be indicated.

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Exclusive Publication of Society Proceedings.

UNDER a caption similar to the above, the *Medical Record*, of this city, gives its views upon this subject as follows:

"At a recent meeting of the Philadelphia County Medical Society, it was decided unanimously that no report of the proceedings should be published, except by the Philadelphia *Medical Times*. Consequently it appears that only the subscribers to the journal in question can be benefited by the deliberations of this learned body. * * * The principle is a bad one—no matter from what side we view it. * * * The members of the society interfere with their interests in limiting their channels of communication with the profession, if not in positively interfering with the prompt and extensive dissemination of professional intelligence. Viewed from this point, the position taken by the society is not only absurdly illiberal, impertinently selfish, but positively stupid."

Since the *Medical Record* is not published in Philadelphia, it has no special interests to serve in this matter, and the views which it expresses may be regarded as the unbiased conclusions of the editor. With these views we entirely agree, and we commend them to the attention of all scientific societies. Every society that has the general advancement of science at heart, and not the personal interests of individuals, will give as wide a circulation as possible to its proceedings.

THE AMERICAN

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AND

POPULAR SCIENCE.

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

MR. CHARLES STODDER, 181 Devonshire Street, Boston.
S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 48 Madison St., Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

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The Micrometric Standard.

THOSE of our readers who take an interest in the subject, are, of course, familiar with the action taken by the Microscopical Congress at Indianapolis in regard to micrometric units and standards. That action is now generally considered to have been too positive and definite, for the simple reason that the subject had not been sufficiently discussed or considered by the members present. The same resolutions which were passed at the Indianapolis Congress were also brought before the New York Microscopical Society, and the most important part of them—that relating to the micrometric unit—was passed with very little discussion. At a subsequent meeting, however, some of the members had the subject reconsidered, and the former action was unanimously rescinded.

The Troy Scientific Association has evidently gone to work the right way, and proposes to secure full and free discussion of the subject, as the following circular shows:

TROY, N. Y., Dec. 2, 1878.

Prof. John Phin, Editor American Journal of Microscopy:

DEAR SIR—The undersigned have been appointed a committee by the Microscopical Section of the Troy Scientific Association, to confer with other microscopical societies in regard to the subject of micrometry, which was referred to the societies by the late Microscopical Congress at Indianapolis.

Our society earnestly desires the success, in some practicable form, of the movement suggested by the Congress, but believes that much further preparation will be required to enable the American Society of Microscopists to take any definite action upon it at the Buffalo meeting next summer. That such a movement should be other than a failure, it must be entered upon after mature deliberation and full consultation, and in such manner as to secure the general and cordial assent of those who are prominently interested in, and qualified to judge of, the subject. To secure the preliminary investigation and the moral power necessary to this end, if the end be now attainable at all, we invite the co-operation of the societies, and suggest the appointment of a committee whose duty it shall be to investigate the following questions, confer with the societies, and with persons known to be experts in this department, and report to the American Society at its next meeting:

1. Is it expedient at present to adopt a standard for micrometry?

2. If so, should the English or the metric system be employed?

3. What unit, within the system selected, is most eligible?

4. What steps should be taken to obtain a suitable standard measure of this unit?

5. How can this standard micrometer be best preserved and made useful to all parties concerned?

In our judgment, this committee should adequately represent not only the societies, but also those microscopists who are not members of the societies, and it should especially include those who are distinguished as physicists. We suggest that it be formed in one of the two following ways:

a. Each society eligible to representation at the late National Microscopical Congress may appoint one member of the committee, which shall be considered formed when at least five members are appointed; the societies to have power to fill vacancies, and the committee to have power, unanimously, to add to their own numbers; or,

b. Each society may render a ballot for five persons, not necessarily members of any society, and not more than one of whom may belong to any one of the local societies; the vote to be canvassed by the Secretary and approved by the President of the American Society of Microscopists, the seven highest on the list, ties, if any, being decided by lot, to be considered elected, with power to fill vacancies, and, by unanimous vote, to add to their numbers.

Should the committee, however formed, be inconveniently large, it can act by means of a sub-committee, whose action would acquire additional weight by being approved by the whole committee.

Will you be kind enough to let us receive, as promptly as convenient, your opinions and suggestions about this matter, and the desire of your society, or of its most active members, if that of the society as a whole cannot now be obtained.

Yours very respectfully,
R. H. Ward,
A. W. Bower,
Committee.

The views of the editor personally are perhaps of small consequence, but as an expression has been so courteously invited, we cannot refuse to give it.

We feel that it would be inexpedient at present to make the adoption of any system *mandatory*. It will be well to *urge* the general use of the metric system, but any resolutions which look to the exclusion of papers in which this system has not been adopted are to be deprecated.

No special piece of glass or brass can be declared to be *the standard*. The standard to which all micrometers must be ultimately referred is the Paris metre and its subdivisions. It might, however, be well to have a verified copy of a portion of this metre in the possession of some national body, and provision might be made for the comparison of other micrometers with it. But it is evident that this cannot be the *standard*, and will not be accepted as such by European microscopists, with whose work it may be frequently desirable for us to compare ours.

As regards a unit, we are decidedly in favor of the inch for the English system, and the millimetre for the metric system. Any new unit, not familiar to scientific men in general, is to be avoided. And it must be remembered that microscopists include almost every division of scientists. In addition to a host of amateurs, who use the microscope for its own sake, there are numbers of botanists, zoologists, physiologists, chemists, physicists, geologists, etc., etc., who use this instrument, and it is of great importance that no barriers be placed between these workers. The inch and millimetre are known all over the world, and to every one having the least acquaintance with science; a new unit would be familiar to but a few. Therefore let us avoid it. And besides, there is no necessity for it. The placing of a decimal point is all that is involved.

The Troy Scientific Association has gone to work in this matter in a manner worthy of all praise. A calm, earnest discussion of the subject cannot but result in good, while hasty and inconsiderate action may do great harm.

Our Book Table.

Urological Dictionary: Containing an Explanation of Numerous Technical Terms; the Qualitative and Quantitative Methods Employed in Urinary Investigations; the Chemical Characters and Microscopical Appearances of the Normal and Abnormal Elements of Urine, and their Clinical Indications. By John King, M. D. With Twenty-seven Useful Tables and Thirty-nine Wood Cuts. Cincinnati: Wilstach, Baldwin & Co.

In this work the author has brought together an immense amount of useful information which has hitherto been scattered, and, consequently, unavailable to the majority of medical practitioners. The chemical portion seems to have been edited with skill and care, although we notice a few oversights, as, for example, where it is stated that cotton is dissolved by ammoniacal solution of copper; it is not every ammoniacal solution of copper that will dissolve cotton. It is to be regretted, however, that the microscopical department is hardly up to date. Indeed, no further indication of this fact is needed than the frontispiece, in which the author has chosen as an example of a "Large Microscope" the stand made by Spencer thirty years ago. A list of microscope makers is given, but nothing is said of the work of American microscope makers who have arisen during the last ten years. As another example of the extent to which the book is behind the age, we may call attention to the fact that in giving a list of books which are recommended to students of microscopic urology (if we may be allowed to use the expression), the only authors named are Carpenter, Beale and Notcutt. The first and last do not treat of medical matters at all, and Notcutt's book is inaccessible to modern students, having been long out of print!! Why the works of Richardson, Schaeffer, Rutherford, Harley, and a host of others, who give minute directions for using the modern microscope, should have been so completely ignored, and a book like Notcutt's, which is utterly out of date, useless, and not to be had if it were good for anything, recommended, we cannot conceive.

A want of care and discrimination is also evinced in the matter of authorities. For example: Under the article "Blood," we find marked consideration given to the views of "Prof. Fairfield, of the New York College of Veterinary Surgeons," who expresses "doubts as to the disc-like form and biconcavity of blood corpuscles." Whatever the real histological facts may be, no one who has read the papers of Prof. Fairfield would attach any importance whatever to his conclusions. We are very sure that our readers will agree with us in this view, when we state that one of the optical laws laid down by Prof. Fairfield is that "whenever a ray of light passes from a rarer into a denser medium, it always enters the latter at right angles to its surface"!!! And, lest it should be suspected that the types or his pen have been playing pranks with Prof. Fairfield's thoughts, we will state that he illustrates his paper with a figure in which this idea is consistently carried out, the rays of light striking the slide at various angles, but always passing into it at "right angles to its surface." Moreover, after passing through the slide the rays strike the corpuscle (which is figured as globular), and no matter at what angle they strike the surface, they are at once bent so as to enter it at a right angle to the tangent at that point, and proceed *directly to the centre*, where they cross and then pass on and out!! Our readers will readily see that, according to Prof. Fairfield, the focus of a Coddington lens is at its centre. And yet Prof. King gives sufficient consideration to this farrago of nonsense to introduce it, or at least the resulting conclusions, into the pages of a work which will, with many, become a standard.

We point out these blemishes with the greater freedom from the fact that the book is really of great value as an encyclopædia of existing knowledge. We trust that a second edition will soon be called for, so that the author may have an opportunity of remedying the defects which exist in the present one.

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Melting Point of Fats.—It is often desirable to use a fat which will melt at a certain temperature. In practice a fat melting at a specified temperature may be made by mixing wax or tallow with some fat melting at a very low temperature. The melting point of a large number of fats is given in the following table:

Butter (cow) fat	31—32.5° C.
Cacao "	25—27° C.
Badger "	25—28° C.
Elephant "	26—28° C.
Fox "	50—54° C.
Goose "	12—25° C.
Hare "	45—48° C.
Dog "	23—27° C.
Goat "	30—33° C.
Calf "	45—55° C.
Camel "	50—55° C.
Human "	22—26° C.
Horse "	50—60° C.
Ox "	36—40° C.
Hog "	28—32° C.
Wax, yellow	60—68° C.
" white	65—69° C.
" Japan	50—60° C.

TRANSACTIONS OF SOCIETIES.

Note.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Nov. 7.

The accessions to the library and cabinet were unusually numerous and valuable. Dr. B. S. Warren, of Waltham, Mass., sent a box of sixteen slides of diatoms, and some vials of material ready for mounting. All the slides are from famous localities, and contain interesting species—Navicula rhomboides, Coscinodiscus complexus, etc. A vote of thanks was given Dr. Warren for his kindness.

Mr. Chas. W. Banks, Corresponding Secretary, presented an old book (1756), "Essai sur L'Histoire Naturelle des Corallines, etc., etc., par Jean Ellis," a translation from the English of that early microscopist, John Ellis, of the Royal Society—an early, but, judging by the many marvellously executed plates of this valuable work, a good worker. The forty colored (by hand) plates show an accurate examination of numerous marine animals, especially the Sertularians, many of which seem identical with our Pacific Coast species. Mr. Banks' discriminating liberality deserves much praise.

A number of New Zealand diatom earths were received in exchange from Mr. John Inglis, of Canterbury, N. Z., with some interesting notes.

The return of Dr. Harkness from his work with cryptogamic botanists in England and on the Continent, was noticed with pleasure by all present, and his verbal contributions to the evening's topic, "The Microscope in Medicine," were well received.

Professor Ashburner showed a wonderful photograph of Amphipleura pellucida, taken by Tolles with his one-tenth immersion, 2,500 diameters. The perfectly even and exact definition was remarkable. Dr. Dennis read a report of the Buffalo Microscopical Society's proceedings, making mention of the next year's meeting of the American Society of Microscopists, to be held in Buffalo. Mention was also made by Dr. Dennis of the new "American Quarterly Microscopical Journal," and subscriptions urged.

Professor Hyde spoke of Dr. Piper's work in discriminating between the blood-corpuscles of various animals. It was agreed that experts in such matters can give testimony of only negative value. It may be said that a certain blood stain is *not* that of some animal, but as to identifying it, that is impossible.

Some slides of diatoms, dredged from Lake Tahoe by President John LeConte, in the course of some physical investigations upon that body of water, were submitted to the Society for determination, and President Hyde was appointed to take charge of the matter.

Mr. Moore having resigned, Dr. G. L. Murdock, upon the nomination of Professor Ashburner, was elected to the office of Treasurer. "The Microscope in Law" having been selected as the next topic, President Hyde then read for the writer a paper on "The Fruiting of Sea Lettuce," by C. L. Anderson, M. D., as follows:

"A few days ago I collected a quantity of *ulva latisima* for my marine aquarium. The fronds were well grown (October 26), of a beautiful deep green color. The plant was put into the water at night. Next morning, quite early, the water had a turbid look, and I feared there was too much dead matter ever to become clear; but as the sun came to shine on the side of the aquarium, I noticed a band of green matter bordering the side in the sunshine, and adhering, apparently, to the glass at the upper surface of the water, and the aquarium was clear. When the green band was touched, there seemed to be a dispersion of the material, but readily coming together again. Like a cloud of very minute insects, they were constantly changing the form of the mass, and, amœba-like, throwing out processes here and there, the greater part, however, clinging to the glass. Putting a small quantity under the microscope, I found two kinds, or forms. One was quite round, and moved slowly, with an irregular rolling motion. I could not detect cilia, although the motion would indicate their presence. The other form was smaller, conical, and very active, moving so rapidly that at first I could not make out its form. A careful inspection revealed the fact that they were the zoospores of the ulva. The conical form had filaments at the apex. Carpenter says 'ciliated.' I would rather consider them as accessory to cilia, and intended as holdfasts that the plant may grow. Both Dr. Carpenter and Dr. Wythe present illustrations of these zeospores, showing their development from the frond cells of the ulva, and Carpenter remarks that 'they might easily be taken for true infusoria.' And so they might. On further examination I found some of these zoospores clinging to the broken walls of the cells, both forms, and exhibiting active exertions to be free. As to the generative process, of which Carpenter says, 'nothing whatever is known,' I am of the opinion that the filament spores are fertilized after their escape from the cell by the round spores, and that the latter, having performed their function, like the anther-flowers, disappear, and the filament spores become fixed and grow by the multiplication of cells peculiar to other algæ. The next morning these zoospores had diffused themselves into the water, and the turbidity remains as it was the first morning before the 'swarming.' It is likely that nearly all these germs have perished in the water for want of a congenial place to become attached that they might grow."

The regular bi-monthly meeting of the San Francisco Microscopical Society, held Thursday evening, Nov. 21, proved even more interesting than usual. Both Dr. Harkness and Mr. H. G. Hanks (honorary members) were present, the latter the first time since his return from Europe. The topic of the evening was a paper by President H. C. Hyde on "The Microscope in Medical Jurisprudence." This paper will appear in full in our next issue.

Microscopical Section, Troy Scientific Association.—The regular monthly meeting of this section was held at the residence of Mr. Richard Allen, with a good attendance of members.

Rev. A. B. Hervey introduced the subject of the development of the cellular structure of plants, illustrating it with a variety of excellent preparations. The subject was discussed at length by all the members present.

Dr. Ward introduced the subject of micrometry, which was referred to the local microscopical societies by the National Microscopical Congress, which met at Indianapolis last summer. Resolutions which were passed by the Congress recommended the adoption of the metric system of measurement as not only the most convenient yet proposed, but also the only one that can possibly become universal, suggested the one-hundredth of a millimetre as the unit of measurement with the microscope, and advised the adoption as a standard of a series of plates, ruled by Prof. William A. Rogers, of Cambridge, which should be distributed to the different local societies for the comparison and correction of all other scales.

The Section referred these recommendations of the Congress to a committee consisting of Dr. R. H. Ward and Prof. A. W. Bower. It is understood that the first recommendation as to the metric system will be favored, but that the proposal to adopt the one-hundredth of a millimetre is thought inexpedient, as the millimetre itself, or the centimetre, will be not only more easily adopted on account of its familiarity, but will be really more convenient for use than the nameless and unfamiliar fraction proposed. The adoption for present use of a scale prepared by Prof. Rogers, will be reported favorably, because these scales, while not claiming to be absolutely perfect, and beyond the possibility of future amendment, are believed to be far more reliable than any others heretofore made in any country. Instead of six plates, all of which shall be called standards, it will be recommended to adopt one as a standard, and regard the other five as verified copies of it. By correspondence between the different local societies, an effort will be made to have this important subject ready for mature action at the meeting of the Society of American Microscopists, which is to be held at Buffalo next August.

Buffalo Microscopical Club.—An interesting and well attended meeting of this club was held at its usual place of meeting, the rooms of the Grosvenor Library, on the evening of the 12th of November.

Prof. D. S. Kellicott, of the Normal School, read a paper, illustrated with blackboard and pen-drawing sketches, on the structure and life-history of an interesting fresh water Lernean, found on the rock bass of the lakes. He had determined it to be Lerneocera crucicata of Le Sueur, as described by him in 1824. The Professor presented several facts and peculiarities in its history and anatomy not heretofore published, preceded by a general resumé of the characters of the genus, in accordance with existing descriptions, to which were added some notes of his own original observations.

Mr. Ward called attention to his discovery, in a private residence in the city, of the destructive larva of the carpet beetle, Anthrena scrophularia, and described its beautiful appearance.

Dr. Howe read some experimental notes relative to the injection and preparation of animal tissues for class illustration, with illustrated specimens.

Mr. Fell presented some excellent examples of dry mounting for opaque objects by means of wax cells. Conversation, and the usual exhibition of novelties, closed the session.

The Buffalo Microscopical Club held its next regular meeting, Nov. 10, at the same place.

The Secretary, Mr. Jas. W. Ward, read a translation of an instructive paper on malignant tumors, microscopically and histologically considered: a pathological study, originally read by Dr. Ledeganck, before the Belgian Royal Academy of Medicine. As the paper presented some bold and somewhat revolutionary ideas concerning cancerous degeneration, and the true diagnosis of abnormal tissues—carcinomous and other—its fuller discussion was deferred till the next meeting of the club.

Mr. Fell presented some suggestions in favor of the use of revolving tables at evening exhibitions of a popular character. Prof. Kellicott communicated a note on the discovery of a species of marine crustacea in the waters of Lake Erie. He had captured a species of Mysis in the hydrant water, thus confirming the previous detection of these creatures in the waters of the great lakes by Stimpson and Hoy. Prof. Kellicott also stated that the body of the Mysis was covered with a marine protozoa, Acineta tuberosa, a fact additionally interesting in connection with the fact recently mentioned by Prof. H. L. Smith, of the occurrence of marine forms of diatoms in the waters of the lakes.

Prof. Kellicott showed the Hydra viridis infested with that peculiar parasitic infusoria, the Trichodina pediculus.

Mr. Fell also read a note of the observation of a destructive parasite infesting the hydra.

Mr. Ward exhibited the new Woodward illuminating prism, mounted and simple, as made by Mr. Geo. Wale, of Paterson, N. J.

A committee of conference was appointed relative to the project for a concurrent determination of a standard unit of micrometry.

JAS. W. WARD, Secretary.

EXCHANGES.

Good pocket magnifier, 1 lens, 1⅜ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 248, Greenport, Suffolk County, N. Y.

Wanted, a human skeleton, articulated or non-articulated, in exchange for books, microscope, etc. E. Riedel, 318 East Fifty-third street, New York.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

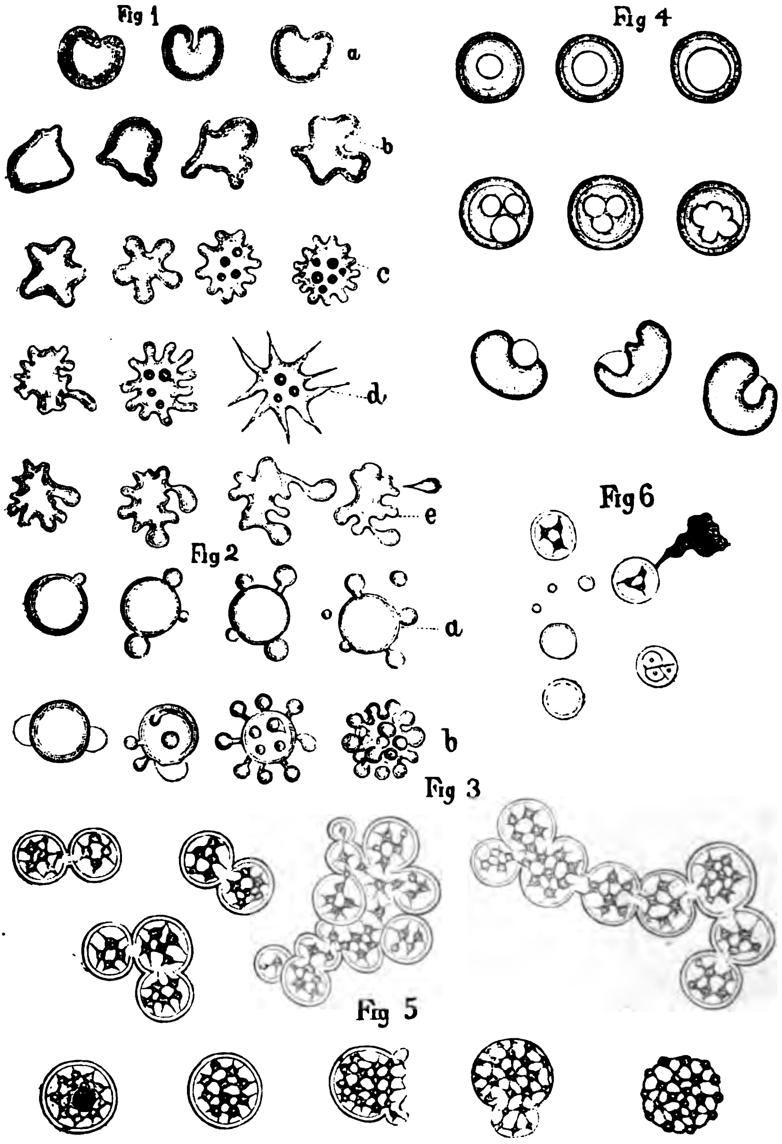
Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 352, Worcester, Mass.

Large quantity botanical species indigenous to this section, well preserved, to exchange for similar of other sections of U. S. H. F. Jaeger, 455 Dearborn Avenue, Chicago, Ill.

Spines of Euplectella speciosa (glass sponge); also globular sand from Great Salt Lake, for other good material. J. Gayler, Ridgewood, Bergen County, N. J., Box 104.



STRUCTURE OF COLORED BLOOD CORPUSCLES.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

VOL. IV.

[For the year 1879.]

NEW YORK:
INDUSTRIAL PUBLICATION COMPANY,
14 Dey Street.
1879.

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THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. IV. NEW YORK, JANUARY, 1879. No. 1.

Structure of Colored Blood-Corpuscles.

ON the 16th of December, 1878, Prof. Elsberg, M. D., read before the New York Academy of Sciences a Paper on the Structure of Colored Blood Corpuscles, of which the following is an abstract:*

In the course of some introductory remarks, he stated that the discovery of red corpuscles in the blood was one of the first results of microscopical study over 200 years ago; that since that time no other constituent of the body has been more frequently examined; nevertheless their structure had not heretofore been ascertained.

His own success he ascribed to the method which he pursued, viz: mixing a drop of fresh blood with a drop of a 40 per cent or 50 per cent saturated solution of bichromate of potash, and examining with high power (1,000 diameters or over). His investigations have determined some points in addition to the structure. These are:

(1.) As to uniformity of size. Dr. Richardson, of Philadelphia, and others, believe that "the variations above and below the standard size of corpuscles from any particular animal are comparatively slight in fresh blood;" while most microscopists hold, with Dr. Woodward, of the U. S. Army, that "the truth is that not only do the individual corpuscles in every drop of blood vary considerably in size, but as might be anticipated, from this very fact, the average size obtained by measuring a limited number of corpuscles (50 to 175, still more in the case of but 10 to 50, as usually practiced) varies considerably, not only between different individuals, but also between different parts of the very same drop of blood." This point is sometimes of the greatest possible importance in criminal cases. Dr. Elsberg found in every person's blood that he examined some red corpuscles as small as, or smaller than, the 1-3848, and some as large as, or larger than, the 1-2678 of an inch in diameter (*i. e.*, .0066 and .00948 mm.), with transitional sizes between these; but in each specimen the majority of red corpuscles were of about one size, which, though differing in different specimens, was most frequently between the 1·3750 and the 1·3000 of an inch, *i. e.*, .00676 and .00845 mm. The colored blood corpuscles of monkeys, dogs, wolves, and some other mammalia, come within these limits, while those of sheep, goats, cats, horses, and some others, are smaller in size.

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*Dr. Elsberg's paper will appear in full, with additional illustrations, in the Annals of the New York Academy of Sciences, Vol. I, Nos. 9 and 10, (1879.)

(2.) As to variations of shape, Prof. Elsberg has observed changing "rosette," "stellated," and "thornapple" forms, such as are represented in rows *c* and *d* of Fig. 1, and the occurrence of indentations and protrusions like those seen in rows *a* and *b* of Fig. 1, which either persist or are leveled again; protrusion of knobs, either pedunculated or sessile, which sometimes are so numerous that they surround the body of the corpuscle like a wreath, represented in Fig. 2; decrease of the size of the main body by detachment of knobs, (seen at *e*, Fig. 1, and at *a*, Fig. 2); vacuolization of corpuscles (such as are variously represented in Fig. 4), and transformation of many of the portions detached into vacuolized globules which increase in size. Such active form-changes settle in the affirmative the question hitherto often discussed and usually decided in the negative, whether or not these corpuscles are composed of living matter possessing contractility; though Beale says: "They are no more living than cuticle, or the hard horny substance of nail or hair is living." Fig. 3 gives an idea of the grotesque shapes sometimes met with from the coalescence of two or more colored corpuscles into chains or other compound forms.

(3.) The much vexed question of an investing membrane is at last set at rest by the demonstration that the outer portion of the corpuscle, although essentially like the inner substance, may be considered to be differentiated from the latter, especially at the periphery of the disk, where it constitutes an encircling band of uniform thickness (as is represented in the first two corpuscles of Fig. 5), or sometimes (as shown in the last corpuscle of Fig. 5) as though it were formed by a wreath of beads, each bead separated a little from its neighbors on the string. From this appearance, it is not to be wondered at that so many careful observers have hitherto ascribed to colored blood corpuscles the possession of a separate investing membrane.

(4.) As to the presence of a nucleus in any adult human or mammalian red blood corpuscle, Dr. Elsberg states that as a rule there is none, but that occasionally there is seen in the interior of such a corpuscle an accumulation of matter, which may be interpretated as a nucleus (such a one as is seen in the first corpuscle of Fig. 5). Among others, Prof. Stowell's publication in this journal* confirmatory of Prof. Böttcher's experiments to prove the existence of nucleated human and mammalian red blood corpuscles, is referred to; but Brunn and others are quoted, according to whom "the appearances produced by both of Böttcher's later methods are artificial and optical effects due to the action of the reagents on the substance of the blood corpuscles."

On all of these points and others, Prof. Elsberg has given an extraordinarily complete account of the literature of the subject. In the demonstration of the structure we will follow him in detail.

"Soon after the specimen of blood is ready for examination, a difference is noticeable in the intensity of coloration of the corpuscles; some are paler than others. There is a great difference in the rapidity of "paling" in blood taken from different persons, even in blood of the same person taken at different times and with different strengths of the admixed solution of bichromate of potash. Usually, in blood of healthy persons, mixed with a 40 or 50 per cent saturated solution, and examined with high powers, in about an hour, a few of the corpuscles least deeply colored appear to have become somewhat granular in their interior. Soon the granules or dots seem more distinct; short conical thorns or more delicate spines appear to issue from one or two of the largest of them; and on close inspection and focussing some appear to be connected by irregularly concentric filaments. In the course of five minutes more, a complete network is distinctly seen in the interior of one or more corpuscles, and what at first appeared to be granules turn out to be thickened points of intersection of the threads forming this reticulum. All the corpuscles represented in Fig. 5, and to some extent those of Figs. 3 and 6 show this network. The dots or points of intersection are irregularly shaped and vary in size. Radiary threads of the network terminate at the periphery of the corpuscle either with thickened ends connected by threads, as in the last corpuscle of Fig. 5; or, what is more usual, with terminal points lost in an encircling band of a uniform thickness, often greater than either the interior threads or most points of intersection, as in the first two corpuscles of Fig. 5. As the "paling" progresses, an increasing number of corpuscles show the interior network, identical in construction with the network discovered by Heitzmann* in amœba, colorless blood corpuscles, and other living matter of the body—a discovery which Dr. Elsberg has brought to the attention of the American Medical Association more than three years ago.† Gradually an interior network structure becomes visible in nearly all the corpuscles in the field except the smallest, which appear more or less compact. Some movement takes place in the network, for sometimes the threads change in length and perhaps in thickness, and the dots change their position and their size. In the course of another half-hour or hour, the network becomes less distinct in the palest corpuscles, and in these gradually fades away. Then, for some time, the network remains visible in nearly all corpuscles, except those that are too pale or too small; vacuoles, one or more, appear in many of the latter, while the former occasionally show indications of irregularly massed matter in their interior, though usually nothing is seen of them but double-contoured rings, which have been called their "ghosts." During this time, also, a quantity, sometimes quite large, of detritus, accumulates. In Fig. 6 an attempt has been made to depict the appearance of some of the corpuscles at this stage; two still show traces of a network, there is some detritus, the lowest figure on the left represents a so-called "ghost," and the highest on the right a corpuscle out of the interior of which a considerable mass of matter has been protruded.

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*"American Journal of Microscopy," June, 1878, page 140.

It appears as though the network is most plain in corpuscles that have suffered either not at all or but little from detachment of a portion of their substance. The active changes of indentation and protrusion have usually disappeared in a large number of corpuscles by the time "paling" has sufficiently progressed to render the interior structure visible. Some corpuscles permanently retain scalloped and knobbed forms, while the majority are finally more or less rounded off; but the play of changing shape of many corpuscles is going on at the same time that their network is seen. After a while, further "paling" stops, and the network structure of all corpuscles which show it remains visible indefinitely long." Some blood corpuscles show it which have been preserved for nearly three years.

The colored blood corpuscles of lower animals have essentially the same intimate structure as that described in man's. Dr. Elsberg has detailed his observations of those of the ox and the newt—the one an example of the unnucleated, the other one of the nucleated corpuscles.

In conclusion, some remarks are made on the power of dilute solutions of bichromate of potash to preserve the most delicate animal structures. Heitzmann's views of contraction and extension of living matter are then presented, illustrated by schematical drawings copied from this investigator's publications in Vienna and in this country. These views are shown to have materially enlarged the bounds of human knowledge of the constitution of living matter, and are here used to explain the form changes of colored blood corpuscles.

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* "Bau des Protoplasmas," Sitzungsberichte der Wiener Akademie der Wissenschaften, Vol. 67, (1873), Div. III, p. 100.

† "Notice of the Bioplasson Doctrine," Transactions of the American Medical Association, Vol. XXVI, (1875), p. 157.

Artificial Crystals of Gold and Silver.

BY ALBERT H. CHESTER.*

IN casting bars of pure gold for the manufacture of foil, traces of crystallization may often be observed upon their upper surfaces, and sometimes distinct crystalline forms. These are generally simple triangular faces slightly raised, very similar in appearance to specimens sometimes found in nature. Occasionally several faces of the octohedron may be seen, the edge in some instances being half an inch in length, and quite sharp and well defined. The purer the gold is, the more likely the crystals are to form, and they are oftenest seen when the bars are cast from that which has been previously crystallized by the battery process described below. The presence of a very small amount of copper seems to prevent it entirely, and the surface of the bar is quite smooth. It is perhaps worthy of notice that the forms observed are always triangular and never hexagonal, as is so frequently the case with natural crystals of gold. They do not seem to be distorted or flattened at all. Neither do the dendritic forms so common in nature, and now quite easily obtained artificially, appear on the surface of the bars.

The precipitation of gold from solution by the aid of a battery is a well known process in the common operation of electro-gilding, but to deposit it in the crystalline form is a process of comparatively recent date, having been patented in 1860, as a method of preparing gold for dental purposes. The process is briefly as follows. A solution of chloride of gold and ammonium is placed in a shallow dish coated with heavy gold foil, which is connected with the zinc plate of a large Daniell's battery. Near the top of the solution, and connected with the copper plate of the battery, a roll made up of thin strips of pure gold is suspended, enclosed in a muslin bag. The strength of the battery current is controlled by a coil of wire arranged as a rheostat, a clamp terminating one of the battery wires, enabling the operator to include a greater or less number of coils in the circuit. The necessary conditions being fulfilled, on completing the circuit the gold is gradually dissolved from the roll, and deposited on the bottom of the dish in bright crystalline flakes, having the appearance of feathers or fern leaves when examined under the microscope. Fig. 1 shows one of these crystals magnified one hundred and fifty diameters. At first sight, this appears to be like certain natural crystals occasionally found, and the arborescent forms of other isometric minerals. But all such crystals that I have seen have invariably the angle of 60° between the side ribs and the midrib, making an angle of 120° between the two sets of ribs. Gold, silver and copper all show this characteristic, which is particularly well illustrated in the crystals described by Professor Vom Rath in the last volume of Groth's "Zeitschrift für Krystallographie." This arrangement of the ribs into two sets, each making an angle of 60° with the midrib, is very beautifully shown in the arborescent crystals of copper, sometimes formed in connection with the Hunt & Douglas process for separating that metal from its ore. It is quite difficult in the case of these artificial crystals to measure their angles, because the midrib is usually more or less curved, and the whole form presents great irregularities. It can only be done approximately for a single crystal, but by making a large number of

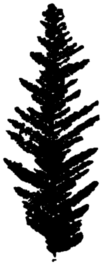

Fig. 1.

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*The original paper on artificial gold crystals appeared in the "American Journal of Science" for July, 1878.

measurements this difficulty may be in part overcome. The figure above shows a crystal much like the natural ones, the angle on the left of the midrib being about 59°, and on the other side 61°. Such crystals are not often found. Fig. 2 represents a crystal such as is most often seen, where the angle on one side is 41° and on the other 79°. The average of fifty measurements of these crystals taken at random is on one side 44° 38′, and on the other 75° 47′. Nineteen measurements made at another time made the two angles 42° 18′ and 78° 24′. The smallest angle noticed was 30° 36′. The following table of several consecutive measurements shows how wide the variation is, the last column giving the total angle between the sets of ribs:

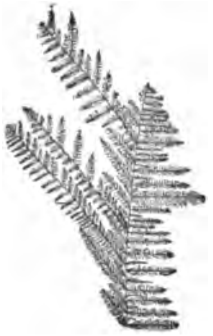

Fig. 2.

30° 36′	89° 30′	120° 6′
41° 54′	78° 18′	120° 12′
46° 48′	73° 48′	120° 36′
35° 36′	84° 24′	120° 0′
53° 42′	64° 48′	118° 30′
49° 0′	73° 36′	122° 36′
38° 0′	81° 6′	119° 6′
49° 42′	69° 54′	119° 36′

It is noticeable that the same angles are carried out in each crystal, no matter how many branches it may have, and the crystal shown in Fig. 2 was selected to illustrate this fact.

These crystals are also curious in being so perfectly flat. Fig. 2 was drawn under a power of 300 diameters without any change in focus. This is very unusual in crystals of the isometric forms, where faces and angles can generally be seen with a low power. Under a still higher power, traces of this structure may be detected in the gold crystals, and in some cases sharp pointed terminations may be seen, which are probably octohedral.

If a film of amalgam is allowed to form on the surface of a piece of pure gold, and the mercury be then driven off by heat, traces of crystallization may sometimes be observed, a network of indistinct crystals remaining. To accomplish this the gold should be perfectly pure, and the heat applied very gently at first. With the greatest pains, however, the result is not always, or even often, satisfactory. The surface is generally left in an amorphous condition, or at best covered with angular depressions. Very rarely, and under conditions not fully understood, the crystallization is distinct enough to be recognized as such. But distinct though minute crystals of gold amalgam may easily be obtained if the mercury is dissolved out with dilute nitric acid, instead of being driven off by heat. A series of measurements on a number of these crystals proves them to belong to the hexagonal system, having in general the form shown in Fig. 3. The average of forty-eight measurements of the prismatic angle is 119° 53′, the six angles of the most perfect one found measuring as follows:

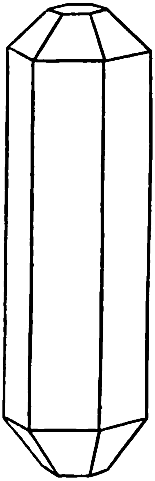

Fig. 3.

120° 30′, 121° 6′, 119° 12′, 119° 6′, 120° 36′, and 120° 12′. The angle O upon 1 has been approximately determined to be about 136°, the roughness of the crystals rendering exact measurement extremely difficult. The pyramidal planes are sometives entirely wanting, the crystal having only a basal termination. The base is often hollow, in one crystal presenting the appearance shown in Fig. 4, the whole base being gone. The sides and bottom of this depression are quite rough, and show no attempt at regularity. Another termination is shown in Fig. 5, where part of the base still remains. Fig. 3 was drawn under a power of 300 diameters, the general shape being retained, but the irregularities taken away. It is about 0.5 mm. in length, and 0.06 mm. in diameter. The gold used in preparing these crystals should be pure and in a finely divided condition. I prefer gold precipitated from solution by ferrous sulphate, washed with dilute chlorohydric acid, and then with water, and dried. This should be treated with about twelve parts of mercury and well triturated in a mortar. The amalgam must then be heated to about 130° C., kept at that temperature for about five minutes, and then allowed to cool gradually. After this it should remain at rest for twelve hours or more. The amalgam, which should be quite fluid, is now to be digested in nitric acid, first of 1.2 sp. gr., and after of 1.4, heating very gently at the beginning, but towards the close of the operation raising it to boiling. The mass left undissolved consists of minute crystals resembling gold in color, but a little darker, and having a greenish tinge. They are quite brittle, and break with a slight touch. They contain about 6 per cent of mercury, which may be driven off without injuring the crystals, by heating them for a short time to a dull red. The mass will then take the color of pure gold, becoming somewhat spongy, and lose entirely its brittle character. This process was patented in 1853, and used for some time in the preparation of gold for filling teeth, making what was called sponge or crystal gold.

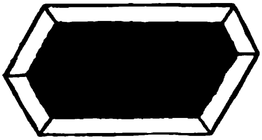

Fig. 4.

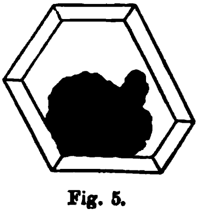

Fig. 5.

The artificial crystallization of silver from a solution of the nitrate by means of some other metal, notably copper or mercury, is a well known operation, and is often performed as an interesting experiment. When done with mercury under the microscope, it forms a beautiful sight, as has been well described in a former number of this journal. In the Ziervogel process for silver, the same form of crystallization is produced on a large scale by immersing copper plates in a solution of sulphate of silver. These crystals are in the form of plates or leaves of irregular shape, sometimes having an arborescent appearance. It is very interesting to watch their growth under the microscope, and they are so readily produced that they are hardly worth a permanent mounting. Recently, in Colorado, I was fortunate enough to obtain some exceedingly interesting artificial crystals of silver, similar in form, but more distinct. They were obtained as an accidental product in the Augustin process, where chloride of silver is dissolved in a solution of common salt. In some out of the way corners, where the solution had been subjected to spontaneous evaporation, probably in connection with organic matter, small quantities of salt were found containing brilliant though minute crystals of silver. They present a very beautiful appearance under the microscope. The crystalline forms noticed are the same as in ordinary native silver, consisting of strings of elongated octahedra, and other isometric forms. They are often somewhat crusted with a yellow sand extremely difficult of removal.

Hamilton College, Dec. 24, 1878.

Trichinæ in Pork.

SOME months ago, Oscar C. DeWolf, M. D., Commissioner of Health of the city of Chicago, addressed the following letter to two eminent microscopists of that city:

OFFICE HEALTH DEPARTMENT,
CHICAGO, Sept. 15, 1878.

Messrs. H. F. Atwood and W. F. Belfield, M.D.:

GENTLEMEN—I am doing what I can, with the means at my command, to detect and consign to the rendering vats all meats exposed for sale or designed for our markets which are unfit for food. More than 200,000 pounds have thus been disposed of to date, the present year.

I am anxious regarding the question of trichinæ in pork, because of the peculiar difficulty of their detection by the unaided eye of our inspectors. Will it be possible for you to make for me a scientific and authoritative examination of the question whether our pork supply is affected with this parasite? or, to what extent? If an examination can be made, I will see to it that the material is on hand whenever wanted; and if trichinæ are found, will you please favor me with a report covering the following points:

To what extent are these parasites dangerous to health or life?

Are trichinous animals generally out of health?

Can reliance be placed upon thorough salting or smoking of meat as destructive of trichinæ?

Are there any practical means by which our meat inspectors can detect the parasite in a carcass of meat?

Such an account of the natural history of the parasite as will instruct the public.

I am, gentlemen, very respectfully your obedient servant,

OSCAR C. DEWOLF, M. D.,
Commissioner of Health.

In reply to this communication, Mr. Atwood and Dr. Belfield submitted the following report:

Oscar C. De Wolf, M. D., Commissioner of Health:

DEAR SIR—In compliance with your request, we have made a series of careful examinations of pork with reference to trichinæ, and have the honor to submit the following report: The samples have been brought to us each day by Officer Lamb, of your force, to whom our thanks are due for his punctuality. He has procured specimens of pork from each of the packing and slaughtering establishments in the city, and at the stock yards. In accordance with our instructions, he took from each hog two pieces; one from the tenderloin *(psoas muscle)*, the other from the ham. We have examined each evening samples from two and sometimes three animals, our method being as follows: Thin longitudinal sections were cut from the muscle, and immediately transferred to the live-box either in water, glycerine, or a mixture of water, glycerine and acetic acid. They were then examined on a Bulloch binocular instrument, with Bausch & Lomb 3-4 inch objective and A oculars, giving an amplification of about seventy-five diameters. Most of the sections were examined by each of us independently; hence we feel reasonably confident that no trichinæ escaped our observation. From the one hundred hogs we examined nineteen hundred and twenty-seven sections, or nearly twenty from each hog.

We had intended examining upward of one thousand animals, but, on account of your urgent request for an early report, and because the average of infected ones was so uniform, we have consented to give results arrived at on the first hundred.

Eight of the one hundred hogs were infected, the ninth, twenty-fifth, twenty-ninth, fifty-third, fifty-fourth, sixty-third, seventy-sixth and ninetieth hogs containing trichinæ. Some were badly infected, while in others comparatively few parasites were found. In all cases the hams were apparently free from trichinæ, those we found being always contained in the psoas muscle. In the twenty-ninth hog we found the smallest number, there being not more than thirty-five to the cubic inch, while the specimen from the ninetieth hog contained by a careful estimate not less than thirteen thousand in the same bulk.

In reply to your question as to whether trichinous hogs are generally out of health, we would say that nothing in our observations or study would prompt us to answer in the affirmative. It is the normal condition of an animal to harbor one or more varieties of parasites. Van Beneden states, in his work on "Animal Parasites and Messmates," speaking of parasites in general: "They are not more abundant in delicate individuals than in those who enjoy the most robust health. On the contrary, all wild animals harbor their parasitical worms, and the greater part of them have not lived long in captivity, before nematode and cestode worms completely disappear." Moreover, to satisfy ourselves and to demonstrate other facts, we commenced at an early stage in our work to feed trichinous pork to a white rat, then three weeks old. He received a liberal supply of this pabulum from every sample that we found infected. The animal grew rapidly and always enjoyed the best of health, his excellent condition being a subject of remark by visitors at our laboratory. On Nov. 17 we killed the animal, whose muscles were found to be literally alive with trichinæ, from ten to thirteen appearing in every field. Every muscle was infected from the tip of his nose to the end of his tail. This, we think, answers your question in the negative.

You ask, "Are there any practical means by which our meat inspectors can detect the parasite in a carcass of meat?" We would reply that the microscope is the only infallible means. To the unaided eye the infected meat presents no peculiar appearance, unless the parasites be present in excessive numbers. The German government has for some years made a microscopic examination of pork a necessary preliminary to its exposure for sale. The parasite is not destroyed by thorough salting and smoking, as is evidenced by the fact that most of the cases of trichinosis in the western country are traceable to raw smoked hams. To ascertain whether or not an infected ham could be rendered harmless, we instituted a series of experiments in the physiological laboratory of Rush Medical College. As a result of these we found that in sulphurous acid we have an agent which not only instantly kills the worms, but readily permeates the entire ham, and is as readily expelled. Owing to the cheapness of this article, the addition of a sufficient quantity of it to the pickle would add but a trifle to the expense of curing.

In view of the results of our investigations, several important questions suggest themselves. First, why is the percentage of infected hogs so much greater than it was eight years ago? At that time a committee of the Chicago Academy of Sciences examined a large number of hogs, and found but two per cent. infected. We are unable at present to offer any satisfactory solution of this question. Second, why is the percentage of infected hogs so much greater here than in Germany? Englebrecht states (*Anleitung zur untersuchung der geschlachteten schweine auf trichinen*) that of 618,236 hogs examined between October, 1866, and April, 1873, but 70 were found to contain trichinæ. These examinations were made by government officials in the Duchy of Brunswick. We are unable to explain the greater prevalence of the parasite in America, but are at present conducting experiments which we hope may lead to a solution of this problem.

The third and practically most important query is this: Since 8 per cent of our hogs are trichinous, why are cases of trichinosis so rare? We would advance three propositions: First, that in most instances the meat is previously subjected to thorough cooking, whereby the worms are killed. Second, that in consequence of the close resemblance of the symptoms of trichinosis to those induced by other causes, notably typhoid fever, is it not probable that in some instances it has been mistaken for other complaints? Third, that the ingestion of a certain number of living trichinæ is followed by no unpleasant results. In proof of this we adduce the case of the white rat above described, whose carcass, weighing when dressed one ounce, contained not less than one hundred thousand worms. Moreover, in cases where an entire family has partaken of trichinous pork, while some members have experienced serious, perhaps even fatal, illness, others have escaped with little or no indisposition. So firm was our confidence in the harmlessness of a few trichinæ that one of us (Dr. Belfield) ate, on Nov. 20, a portion of the rat referred to, which was demonstrated under the microscope to contain twelve living trichinæ.

At this date no unusual symptoms have resulted from his oriental diet. That the prevalence of trichinæ in the human family is more extensive than is generally supposed is proven by the researches of Turner, Wagner, Virchow, and others, (as stated by Ziemssen). These observers found that from 2 to 3 per cent of all bodies examined, in which there was no suspicion of the presence of the parasite, contained trichinæ. This, too, was in Europe, where the worm is of less frequent occurrence than in this country. Indeed, there seems to be no limit to the number of trichinæ that a man may sustain with impunity; for in numerous instances the bodies of patients, never suspected of having suffered from trichinosis, have been found, post mortem, to contain enormous numbers of these worms. Doubtless in these cases trichinæ were ingested at several different periods, only a comparatively small number having been swallowed on any single occasion. With regard to the natural history of the parasite, we would briefly state the following facts: The presence of the worm in the hog is ascribed by most authorities on the subject to infected rats which he may have devoured. This belief we are not inclined to accept, though we are not as yet in possession of sufficient data for sustaining our theory. Wherever the parasite originates, it usually enters the human stomach encapsulated in pork.

Its condition is then analogous to the pupa state of the insecta. The cyst consists of a connective tissue envelope enclosing mineral matter which consists largely of phosphate and carbonate of calcium. This is not unlike an egg-shell, except that the connective tissue is external, while in the egg the integument is internal to the calcareous matter. Contact with gastric juice causes the disintegration of the cyst, the pepsin digesting the connective tissue, the free acid decomposing the calcareous salts. To ascertain the time required for this process, we procured some juice from the stomach of a dog by means of a gastric fistula. Thin sections were placed in a live box, covered with this fluid, and a temperature of 100° maintained. The worms were observed to escape in from twenty to forty minutes. These worms do no other harm than the infliction of their progeny, which is effected within eight days, each female producing a brood variously estimated from three hundred to one thousand two hundred. The adult parasites are soon thereafter ejected with the fæces. The young trichina shortly after birth forces its way through the intestinal wall, and seeks the voluntary muscles, increasing in size as it progresses. Continuing its course it passes between the muscle fibres, until, arriving at its future home, it pierces its sheath and coils itself up in the fibre. Then follow the phenomena usually occasioned by the presence of a foreign body. The irritation causes multiplication of nuclei, absorption of the formed material, with subsequent fatty and finally calcareous degeneration. Meanwhile the proliferation of cells results in the formation of a connective tissue envelope. The animal is thus enclosed in a living tomb, which it never leaves unless liberated by the gastric juice of another animal. In this condition it remains unchanged for an indefinite time, stated by certain authorities to be sometimes as much as twenty years.

In concluding our report, it may not be

amiss to emphasize the necessity of thorough cooking of pork as a preparation for the table, since the parasite is killed at a temperature far below that of boiling water. It is far from our intent and desire to be classed among the alarmists, as is evidenced by the statement of our belief in the comparative harmlessness of the parasite, an opinion at variance with that usually expressed by previous writers on the subject. These investigations have been conducted in a truly scientific spirit, and we state our results as they actually occurred.

The secular press of this as well as other cities is prone to publish sensational articles emanating from pseudo-scientists on adulterations of food, state of the drinking water, and other subjects of an allied nature. This is to be sincerely deplored, for in the minds of thinking men it leads to distrust of the motives governing such investigations, and to the non-thinkers it does no possible good, but, on the contrary, leads them to conjure up in their minds images of most terrible creatures in and on our every-day articles of food. It gives us pleasure to find that the results of our work will tend to diminish rather than increase the already exaggerated distrust popularly entertained for an article of diet so staple, and one that occupies so important a position in the commerce of our great city, as pork. We have the honor to remain very respectfully yours,

H. F. Atwood,
Wm. T. Belfield, M. D.

Chicago, Dec. 15, 1878.

The Microscope in Medical Jurisprudence.

A Paper read by President H. C. Hyde before the San Francisco Microscopical Society, Nov. 21, 1878.

THE use of the microscope in medical jurisprudence has been mainly confined to the determination of the kind of blood in blood stains, supposed to have resulted from the commission of crime—usually murder, though there is another class of cases involving crimes quite as heinous, which I shall mention later, where the microscope is frequently a determining agent.

The existence of blood is as easily ascertained by the microscope as the details of a distant landscape are made out by the telescope, or as a mass of nebulous light is resolved into separate and distinct points of light by the same instrument.

But this fact alone is not always of enough significance to determine the guilt of the accused, for the mere presence of blood may arise from other causes than the crime with which he stands charged. It may be the blood of some of the domestic animals, and is commonly alleged to be such—as of the ox, dog, pig, rabbit, or some of the domestic birds.

It is here that the best powers of the microscope, and the highest skill of the observer, are brought into play to determine the truth or falsehood of such a declaration, and oftentimes to complete the only wanting link in a chain of evidence that consigns a human being to an ignominious death—the extreme penalty of the law.

It has been popularly supposed, and very generally believed, that the blood of each species of the animal kingdom presented marked and distinctive characteristics, which would enable microscopists to distinguish them as easily as a naturalist would distinguish species.

But such is not the case. There are, it is true, great differences between the blood of the mammalia and that of the reptilia, and of birds and fishes, and there are also some marked differences in the bloods of the mammalia. But, in general, the only difference among members of the same order is in the average size of the corpuscle.

It is apparent that this difference in size is liable to be affected by the expansion or contraction of the corpuscles in the act of drying, and it is rarely under any other conditions than the dried clot or stain that the microscopist is called upon to make the examination.

In consequence of this difficulty, many able microscopists, who have specially investigated the subject, have entertained serious doubts as to the possibility of distinguishing the blood of man from that of other mammalia, and how far, as Prof. Virchow, of Berlin, has observed, "any microscopist may hold himself justified in putting in question a man's life on the uncertain calculation of a blood corpuscle's ratio of contraction by drying."

But the elaborate researches of Prof. Gulliver and Carl Schmidt, to determine the relative size of the blood corpuscle in different species of animals, have now given data so frequently verified, that the examination of blood stains by the microscope has become one of the most reliable methods yet suggested for the discovery of crime in cases where the presence of the blood of the victim is an important item of evidence.

They have ascertained and established the fact, abundantly verified by other observers, that the blood corpuscles of man, the ox, sheep, dog, pig, rabbit, and several other animals, may be absolutely distinguished from each other through differences in average size, ascertained by micrometric measurement; and while these differences may be minute, they are constant in each species, and so marked under the use of high powers, that it is hardly possible for a skilled observer to mistake one for another. Indeed, as Dr. Richardson, of Philadelphia, an extremely able and conscientious worker in this direction, has happily expressed it, these blood corpuscles may be compared to the different sizes of shot, and "it is obvious that the shot dealer in the one case, or a skilful microscopist in the other, would more quickly and surely *distinguish* two analogous sizes of red blood corpuscles or of leaden *globules* from each other than could an inexperienced person in either occupation. So that whilst we might be in doubt whether the shot dissected out of a body was a No. 1 or No. 2, we could have no hesitation, after measuring it with a gauge, in declaring it to be too large for a No. 5 and too small for a No. B, precisely as the corpuscles of man's blood might be confounded with those of a monkey's, but on measurement are seen at once to be too large for those of an ox or sheep."

To quote still further from Dr. R.:

"It must be remembered, too, that whilst the relative differences between corpuscles of human, ox and sheep's blood remain the same, the absolute difference becomes more perceptible in proportion as the discs are magnified by high powers, so that when one corpuscle appears 9.8 of an inch across, and another 5-8 of an inch across, one can hardly be mistaken for the other, any more than a 12-inch shell can be mistaken for a 6-inch shell, even by a very careless person."

Ordinarily, in criminal cases, the microscopist is called upon to determine, not whether a particular specimen is human as distinguished from all other kinds of blood, but to discriminate simply between the blood corpuscles of a man and an ox, a man and a horse, or a man and a sheep, and so establish or disprove the defendant's "story as to how his clothing or other articles became stained with blood."

The ascertained sizes of some of the blood corpuscles are as follows, approximately:

Man	1-3200	of an	inch.
Dog	1-3625	“	“
Ox	1-4260	“	“
Pig	1-4230	“	“
Red deer	1-4320	“	“
Cat	1-4400	“	“
Horse	1-4600	“	“
Sheep	1-5300	“	“
Goat	1-6360	“	“

It will be observed that while the blood corpuscles of some of the lower animals closely approximate each other in size, they are yet so much smaller than those of man as not to be at all liable to be mistaken for those of the latter.

This fact fully answers the objections of those who agree with Virchow that a man's life should not be put in question "on the uncertain calculation of a blood corpuscle's ratio of contraction by drying," because if the blood in question is that of a human being, the contraction of its corpuscles would only render it more liable to be taken for ox's blood, and so diminish the weight of testimony against the prisoner, while all the other blood corpuscles enumerated, being originally smaller than the human, could not possibly undergo any change that would make them nearer resemble the human. The chances of error (if error occurs) are, therefore, all in favor of the accused.

As an illustration of the accuracy of these micrometric measurements, Dr. Richardson, with a Ramsden's cobweb micrometer, measured a series of discs which had been previously measured under several different objectives and forms of apparatus, and computed the average to be 1-3266, as against 1-3236, the average of the former measurement—the total deviation from the true size being only 1-352,292 of an inch; the results being those of an independent observer, seeing the objects for the first time, and determining their magnitude under a magnifying power and measuring apparatus entirely different from those of the former observer. Well may the microscope be called an instrument of precision.

It has been boastfully, but truly, of course, claimed of the spectroscope, that it will detect the presence of blood to the extent of the thousandth part of a grain only. The microscope, in the hands of Dr. Richardson, and with the aid of the very delicate balance used at the United States Mint at Philadelphia, has far exceeded that, for he has obtained a quantity of blood weighing in round numbers the 1-12,000 of a troy grain, and this infinitesimal quantity, moistened under the 1-25 objective, showed many hundred well defined blood corpuscles, ten of which, measured with his micrometer, averaged 1-3494 of an inch in diameter, and "could therefore," as he expresses it, "by this criterion of superior size alone, be diagnosticated from the corpuscles of an ox, sheep or pig, with the same feeling of certainty with which any surgeon could testify that a perforation of the skull, only half an inch across, could not possibly have been made by a bullet measuring an inch in diameter, difference enough to be designated with some detail."

Dr. Piper, of Chicago, has devoted a great deal of research to this subject, and has verified the observations of Schmidt by a novel system of measurement, capable of great accuracy in the hands of a skilful and careful observer, under certain conditions.

He prepares on a piece of paper a figure having rectangular sides, a parallelogram or square, according to the number and arrangement of blood corpuscles he may draw within the lines. Then with the camera lucida he draws the outline of a corpuscle in the corner of the figure, and proceeds to draw the images of other corpuscles in rows until the figure is completed.

By this plan it can readily be seen how the different corpuscles compare in size, and figures can be made containing only the smaller and larger sizes, respectively, for the purpose of making complete tests of the average dimensions.

When completed, the rows in the figures are measured in two directions with an ordinary rule, very accurately, of course. The sum of the measurements of each row in two directions, made with an ordinary rule, is divided by double the number of corpuscles contained in the figure. This gives the average apparent size of the magnified corpuscle, and this divided by the magnifying power, gives the actual average diameter of each corpuscle.

Several tables can be made, each containing fifty or more corpuscles, and a still closer average obtained.

These results may further be verified by micrometric examination in the field of the microscope itself, as in Dr. R's plan.

Each of these methods has its difficulties, however, as well as its advantages.

In the former the well-known factor of error in the micrometric scale is avoided, while the ascertainment of the precise magnifying power used under the constantly varying conditions of focus and adjustment for cover, is a matter of considerable difficulty, although by a series of independent investigations, tables can be prepared to show accurately the magnifying power of a particular glass at a given point of adjustment.

While in the latter method the difficulty lies in determining the accuracy of the micrometric rulings, the fact being well known that there is so wide a variation among glass ruled micrometers that they are rarely to be trusted for accurate measurement without being proved in many ways, at a large expenditure of time and labor. This difficulty may, however, be in the main overcome by the use of high powers and Ramsden's cobweb micrometer.

As I stated at the outset, the examination of blood stains is the principal use of the microscope in medical jurisprudence; but it has been used in other ways, with quite as much success, in the detection of crime. Some of these may be best illustrated by a statement of actual cases.

Some years ago there was a case of child-murder in France. The child had been killed by cutting its throat, and a knife supposed to have been used in the commission of the deed, was found in the possession of the accused. A careful examination showed what were believed to be blood stains, in a crevice between the blade and handle, which had been overlooked in the cleansing process which the knife had gone through, and the substance was submitted to an able microscopist, who, after a thorough investigation, declared that the substance was human blood; that it was blood from the region of the throat—this fact determined by the presence of the epithelial scales peculiar to the fauces, and, furthermore, there he found fragments of rabbit fur. This array of facts was conclusive of the use of that knife in cutting the throat of the murdered child—the additional circumstance being elicited that at the time of the killing, the child had a rabbit-fur tippet about its neck. Confronted with these discoveries, the prisoner confessed her guilt (this unnatural monster was a woman), and was executed.

Another case, which I have met somewhere in my reading, but cannot now recall all the facts, was where the accused attempted to prove an alibi, and would have been successful, but for the fact that his boots were covered with a whitish mud, and it occurred to the authorities to have this examined by a competent microscopist. The examination showed that the whitish mud was diatomaceous earth, and absolutely identical in its contained forms with a deposit close to the spot where the crime had been committed. This conclusively disproved the alibi; at least, so far as the boots were concerned. The general result of the case I have forgotten.

There are other uses to which the microscope has been applied in legal cases, and these will form the subject of a future paper.

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Notes on Diatomaceæ from Santa Monica, California.

A Paper by Mr. Chas. Stodder. Read before the San Francisco Microscopical Society, Dec. 5, 1878.

I HAVE received from Mr. C. L. Peticolas some slides (labeled, Santa Monica, Cal.,) so remarkable that I am desirous to learn the geographical and geological position of the deposit from which the material was obtained. It is remarkable for its great resemblance to the noted Barbadoes deposit, containing large numbers and great variety of both diatoms and polycistinæ, remarkable also for containing numbers of very rare forms of diatoms, first published by Dr. R. K. Greville (in *Quarterly Journal of Microscopical Science*, or "Proceedings London Microscopical Society,") from "Barbadoes Earth," "Monterey," and "California;" one rare species, "Moron, Spain;" one by Ehrenberg, from Greece, and three species of Dr. William Gregory's "Diatoms of the Clyde;" thus bringing together in one deposit species originally found in localities so widely apart both in space and time, and this without noticing those more common forms that seem to be universally distributed.

The following list includes some of the rarest species and genera known, many of them of great beauty:

Cocconeis splendida, *C. major*, *C. pseudo-*

marginata, Gregory; "Diatoms of the Clyde," all recent.

Cocconeis parmula. Bailey et Harvey, Wilkes' Expedition.

Cephyria gigantea. Grev. Monterey, 1866. Some specimens deserve Greville's specific name, but some are not more than half the length of others. There is no doubt about the specific identity with Greville's figure, but he evidently missed one character: the *costae* are closely and minutely punctate. My friend, Dr. A. M. Edwards, was, I believe, an original discoverer of this genus, but Greville anticipated him in publication. I have one example of another species that I cannot identify. It is finely costate, but more specimens are needed to make out a specific description.

Triceratium Articum, 3, 4 and 6 sides—*Tri.* and *Amphitetras Wilkesii*, B. and H.

T. tumidum, Grev., "Barbadoes." A very peculiar and striking form. The specimen differs from Greville's by only more acute angles.

T. ———, n. s. A large, conspicuous form, belonging to the *T. favus* group; but, instead of regular hexagonal cellulation, this has irregular polygonal cellulation, 4, 5 and 6 sides; instead of the minute dots in the cellule of *T. favus*, one dot only. The cellulation is nearest to *T. Thwaitesianum*, Grev.; but all the other characters differ, sides convex, pseudo-nodules (processes) blank and conspicuous, margins opaque; the entire aspect different from *T. favus.*

Navicula praetexta, Eh. "Eocene Marl," Greece, and in the Clyde.

Navicula lyra, Eh., widely distributed.

Eupodiscus occulatus, Grev., "Monterey," rare.

Auliscus nacemosus, Ralf, "Barbadoes," rare.

Amphitetras elegans, Grev., "Monterey," rare. .

Aulacodiscus Oregonus, H. and B.

A. inflatus, Grev., "Barbadoes," rare.

Omphalopelta Moronensis, Grev., "Moron, Spain." This exquisitely marked form is identical with Greville's figure. It may be the same as Ehrenberg's *O. veriscolor*, but I cannot decide from the description. It is not abundant, but there have been a good many found.

Asteromphalus, or *Asterolampra*—a plentiful form on these slides. It is identical with Greville's *Asterolampra variabilis*, "Monterey;" but every example has the distinctive character of Asterolampra. A few other species of Asteromphalus were seen, but lost before the specific characters were studied.

Stictodiscus Californicus, Grev., "Monterey," and, perhaps, one or more other species. In connection with this, I have found discs with the "puncta" of Stictodiscus only; other discs with the "plicate rays" only. I think these both are the separated plates of the valves of Stictodiscus. It is a good question for the Pacific diatomists to investigate.

Rutilaria elliptica, Grev., "Barbadoes," *R. Epsilon*, Grev., "Monterey." Two species of a very curious and remarkable genus. My friend, R. C. Green, of Boston, was an original discoverer of *R. epsilon*, but Greville anticipated him in publication.

A common form in these slides is a mere disc, unlike any diatom in my experience. I propose to call it provisionally:

Discus (a plate) nov. gen., C. S. It is a simple disc., transluoent like porcelain, with no dots, puncta or striæ, or other marks common to diatoms.

D. porcelaineous, n. s.; characters those of the genus, with a ridge sub-marginal, giving it the look of a dinner plate; other examples have a curved ridge in some (not constant) part of the disc.

Grammatophora ———? There is a very large Grammatophora, with delicate puncta in decussating lines.

Arachnoidiscus Ehrenbergii, abundant, and many examples in different conditions, presenting the characters of *A. Indicus* and *A. Nicobaricus*, Eh. These variations I believe to be not organic, but differences caused by the chemicals used in preparing the material, or by decomposition or decay while in the fossil condition. It seems to be questionable whether there is really more than one species of this genus.

I have noticed in this paper the rarer forms, omitting the great variety of Polycistinæ, Coscinodisci, Actinocycli, Actinoptychi, etc.

I have one slide from Mr. Peticolas with the same label, and a parcel of material marked also Santa Monica, containing none of these rare forms, but distinguished by the variety of Polycistinæ, the absence of Arachnoidiscus, and the presence of *Euodia gibba*, Bailey, but with Coscinodiscus and other disc forms. Mr. Peticolas informs us that the material in question was sent to him by Mr. Kinne, and that he has three other materials labeled Santa Monica without this peculiar combination of species. This being the case, it is a matter of interest to all diatomists and geologists to ascertain if there are more than one diatomaceous deposit in Santa Monica. Is this peculiar material a separate deposit, or one layer or stratum in the same deposit from which the other specimens were obtained? If so, in which part of the bed? What is the geological position, Miocene, Eocene, or Pliocene Tertiary? or Cretaceous? All this is of scientific interest, and it is a matter of special interest to the diatomists that the exact locality should not be lost sight of, that a supply may be kept up of these very interesting things.

I cannot conclude this note without expressing my obligation to the work of my friend, F. Habirshaw, in his catalogue of the Diatomaceæ. Having with great labor brought together the names of all published diatoms and reference to the publication, he has saved to the student a vast amount of labor that would be needed to search for authorities, and thus has laid all diatomists under obligations to him.

Charles Stodder.

Boston, Nov. 9, 1878.

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—Edmond About says that an election to the once famous French Academy is no longer coveted by any writer or author of eminence in France.

Microscopic Soirees—An Improved Method of Exhibiting Objects.

BY GEO. E. FELL, BUFFALO, N. Y.

THE scientists who were so fortunate as to attend the Microscopical Congress at Indianapolis, will agreeably remember the *soiree* held in the Court House. In the number and character of the audience, no exception could be taken, the fairest of the fair people of Indianapolis being present in force. Owing, however, to the microscopes being ranged side by side on long tables, in the customary manner, many of the audience could not obtain (in the crowd) a satisfactory view and knowledge of all of the interesting and valuable objects exhibited.

These remarks will justly apply to the great majority of entertainments, in which the microscopes are the only resources applied to the exhibition of objects; and I refer to the Indianapolis *soiree* as among the best representatives of this class of entertainments.

I am of the opinion that they can be considerably improved, so as to be more appreciated by the visitors and exhibitors, and be more beneficial scientifically

The plan I propose may, at first thought, be considered impracticable. I do not suggest it, however, without having had sufficient experience to feel assured that it can be carried out successfully. The question of detail would have to be left to the circumstances surrounding each case, and therefore my remarks are quite general. It must not be inferred from this article that I am a strong advocate of these entertainments, but as long as we use microscopes, we will have them, and any move to improve the present method is worthy of consideration.

My proposition is to have each microscopist furnished with a revolving table of ordinary size, say three and a half feet in diameter, upon which his microscope and lamp are to be placed. In a large assemblage, allot him a certain number of classified objects, from six to ten. In a small one, such number as he may choose, so as to give the guests an opportunity to observe all the objects exhibited during the evening.

From six to eight persons can seat themselves comfortably around each table, and after having viewed and been made acquainted with the nature and peculiarities of the objects allotted to the individual in charge of it, they can remove to another table, and allow others to take their places. In this manner a great many objects can be exhibited in a short time, and with less inconvenience in a crowded assemblage than many might imagine. This was satisfactorily demonstrated at an entertainment lately given in this city (Buffalo), where the plan was carried out at my suggestion.

In a large *soiree*, where arrangements can be perfected in advance, I deem it imperative that no more than the classified list of objects predetermined upon be exhibited at each table. The moment this rule is overstepped, confusion begins, and at different tables the same objects may be exhibited over and over again, and considerable time be thus wasted.

For the information of the guests, it might prove desirable to number the tables, and have placed at different points in the hall placards announcing the objects exhibited at each table, or this information could be conveyed by a printed circular or card, which could be retained as a *souvenir* of the occasion.

A hall *not* furnished with stationary seats, as was a portion of the court room at Indianapolis, would be indispensible in an entertainment conducted on this plan.

The question of procuring revolving tables is the great objection which might be urged against this method. But we will look into it, and soon find that it is not insurmountable. In my opinion every microscopist should have such a table. The expense of changing circular or octagonal centre tables, which are in most every house, into revolving tables, need not be great. One or two dollars will do it; furnish model and casting, and the attachment to the table is a matter of few minutes. The expense of changing my own table, which is firm enough for all reasonable purposes, was less than two dollars, and it has repaid me many times over.

In cities where microscopic societies hold annual reunions, a little effort to secure such tables (a small number being better than none) would render these gatherings much more profitable in every respect.

As compared with the customary method of exhibiting objects, there are many reasons favoring the revolving table plan, a few of which may be stated as follows:

1. The more satisfactory exhibition of all classes of objects (excepting the most difficult tests), as the uncertainty of improper illumination, focalization and movement of objects on the stage of the microscope, is reduced to a minimum, owing to the manipulator having the instrument at all times under his immediate control.

2. The more favorable opportunity of describing the nature of the objects exhibited, and the principles and mechanism of the microscope.

3. The greater appreciation of the exhibition on the part of the guests, who can observe without being subjected to the customary bodily fatigue, the squeezing and pushing, necessarily accompanying the stationary table plan, in a crowded assemblage. This applies alike to the exhibitors.

The combined results being more favorable to the "Popularization of Science," and the enlistment of many in its ranks, some of whom may probably advance to the higher grades. The possibility of such results may be considered as a good argument in favor of the promotion of science through the agency of the microscopic *soiree.*

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— A subterranean forest of oaks has been discovered in Germany, in a valley watered by the river Fulda. Dr. Maesta, a government geologist, who made the discovery during an official exploration, pronounces the trees to be of enormous size, and to date back in their origin to a remote period.

A New Form of Collecting Cane.

MR. ALBERT SMITH, of London, sends us a sketch of a new form of collecting cane, which we reproduce for the benefit of our readers. It consists of a bamboo cane, A, through which is passed an india-rubber tube. To the upper end of this tube is attached an india-rubber ball, D, and to the lower end a glass tube, C. By compressing the ball, D, the air is forced out of the rubber tube and the glass tube; the glass tube is then placed at the point from which it is desired to take a dip, and the pressure on the rubber ball removed. The liquid, of course, rushes in and may be lifted up.

A NEW FORM OF COLLECTING CANE.

* * *

Microscopic Pond Life.

Paper read before the North Staffordshire (Eng.) Naturalists' Field Club, by Mr. T. S. Wilkins.

AFTER a brief introduction, the author pointed out that the special outfit and apparatus of the student of microscopic pond life need not be either elaborate or expensive. A pair of boots proof against puddles, two or three wide-necked corked bottles, a hooked walking stick, or, better still, an elongating stick furnished with a muslin net and a hook, which may be purchased for a few shillings, and a pocket lens, are all that is necessary for an ordinary gathering expedition. To view our objects, no very extensive microscope is a necessity. I shall speak to-night of those objects only which, almost without exception, can be well seen under an inch objective. A few accessories to the microscope will be necessary. A spot lens or some other background illuminator, two or three glass tubes, a small glass syringe, two or three zoophite troughs and cells, a few hollowed glass slides with thin glass covers, and a pair of tweezers, complete the list of indispensables. Of course, if more money can be spared, it is of great advantage to have a binocular microscope and a variety of powers ranging from a three or four inch upwards. A Webster condenser will, perhaps, be found the best dark ground illuminator up to the half-inch; but for higher powers a paraboloid will be necessary.

We are now ready to start upon our first expedition. Let us assume that having done so, we halt at the first permanent pond in our way. Perhaps it is one in an open field—exposed to all winds and weathers—with no trees or bushes overhanging, and with but few weeds growing in it. These are to the microscopist the least productive of all ponds. Fixing the net to the end of the stick, we gently draw it through the water. On examining, we shall probably find in the net half a teaspoonful or so of struggling life. We turn this life into bottle No. 1, and repeat the process two or three times. A glance at the bottle shows it to be crowded with minute beings of some sort. Our next process is to pick up some straggling bits of water weed—all the better if they are a trifle decayed—and these we place in the same bottle. A careful inspection of the edges of the pond should then be made, and any bit of submerged vegetation which bears a brown or whitey appearance picked off and bottled. We have done with this pond, and go on to another. We will assume it to be in the corner of some field partly sheltered and overhung with willows, some of whose branches dip into the water. This, of all others, is the microscopist's pond. Such a one will often prove the abode of Myriophyllum—the Ranunculus Aquatilis and other aquatic plants having finely divided leaves. These finely divided leaves are often crowded with life—quite invisible to the naked eye. The willow boughs beneath the surface of the water will be found crowded with radicles, and from such radicles some of my richest gatherings have been made. Taken and brought home completely at random, it will be found to be the abode of Melicerta, Cephalosiphon, Limnias, and the beautiful Floscule. We will then bottle half a dozen or so of these radicles—those from near the surface of the water are the best—and also some of the submerged Myriophyllum and Ranunculus leaves, and we bid good-bye to this pond well satisfied. We will continue our expedition and assume that we find ourselves on the towing-path side of the Trent and Mersey canal. No hunting ground is equal to this, and I think I am justified in saying that the great bulk of almost all our most interesting forms of pond life may be found abounding there. You are pretty sure to find several species of the Polyzoa, the tube-building Rotifers, and Infusorians, in countless numbers. Our procedure differs somewhat here. I have invariably found it the best plan to probe along the submerged bank of the canal path with the hook—bottling now and then any half-decayed scurvy-looking bit of vegetation, bits of floating or attached jelly like substances, any floating bit of Myriophyllum, and particularly keeping a sharp look out for anything bearing a resemblance to the smaller branches of a fibrous root. And having discovered this, you may be pretty certain you have found one, or perhaps more, of the exquisite Polyzoa — most probably Fredricella or Plumatella. Kneeling on the edge of the canal side, we bring up a handful of these root-like ramifications, and transfer the cleanest-looking portions to another bottle. If now we have been in the least successful, we ought to have a very abundant supply of pond life—objects enough to furnish us with many a quiet hour's enjoyment, and something deeper if we are at all so disposed. On reaching home it will be found of great advantage to turn at least the Polyzoa into a larger vessel. By this means they are likely to live very much longer than if kept bottled up close. We will at once proceed to the examination of the contents of the bottles, and will take first that filled at pond No. 1. Taking up a piece of weed from the bottle, and placing it in a trough filled with water, also taken from the bottle, we shall probably be delighted with some such scene as this. Careering in all directions in a succession of rapid jumps and jerks will be seen a number of water fleas, or Entomostraca—a division of the class Crustacea. They are very common objects of the microscope, scarcely ever absent from any collection of water. Fixed to some portion of the vegetation, we see the common hydra or fresh water polyp, throwing out its long tentacles, which will be seen to deal insensibility or death to the first luckless flea that happens to touch them. The economy of this animal has been very much studied; its mode of increase by budding or gemmation may be easily seen, as it is very common to find an old specimen with two or three young ones growing from it. The hydra is remarkable, too, for the extraordinary power it possesses of reproducing lost parts. Thus a specimen may be cut up into as many as forty bits, and each portion live and develop into a perfect, new animal. Perchance while this extraordinary animal is being eagerly watched, your attention is drawn to a lively and graceful group of little animals, looking in truth like living fairy bells, curling and uncurling their slender stalks with marvellous rapidity. These are the *Vorticellæ Nebulifera*, or bell animalcules, a typical species of the ciliated Infusoria, and looking closely at them, we observe that the outer margin of each little bell is edged with cilia in constant and rapid motion, of such a kind as to give the impression that a complete circlet is made. The result of this is to cause a continuous whirl of water towards each little bell, bringing with it innumerable particles, which our little friend gulps down or rejects, according as they prove food or not. We are still gazing in wonder at this, when there comes sailing into view a most exquisite green ball of the finest network, and our astonishment is increased on observing that inclosed within this ball are several others, similar but smaller of course, they again inclosing others still. As we gaze, others sail into view; gracefully they approach and roll round and round, and past each other, but never jostle, and we ask what can they be. On inquiry, we learn with still greater astonishment that these moving spheres are veritable plants, and not animals at all. You are gazing at the *Volvox Globator*, an organism which, for its size, has been the cause of more scientific controversy than any other thing.

To be continued.

A New Rotifer.

BY D. S. KELLICOTT, BUFFALO, N. Y.

AMONG the *Rotifera* frequently met with in Niagara water at Buffalo is one of more than usual beauty, even in a group that presents so many wonderfully beautiful forms. It attracts especial attention on account of the very long formidable looking setæ with which its carapace is armed, the gracefulness of its movements as it passes steadily around the obtuse curves of its path, and the highly "decent proportion and symmetry of its parts." After searching through Pritchard, Dujardin, the manuals, and various scientific journals, I am unable to find either figure or description of it. I have also sent the rotifer, or a drawing of it, to several gentlemen wise in the lore of small things, without success in finding its place, and as I know of no one in this country to whom I can refer it for authoritative determination, I venture to publish a figure and description; also to propose a name, expressing the hope that, if the species is already named, the one proposed may not get into the synonymy.

Following Ehrenberg's arrangement of the group, a diagnosis ends with the genus *Anuræa;* thus: wheel organ divided—*Section II, Sorotrocha;* wheel organ divided into two parts—*Division* 2, *Zygotrocha;* carapace present—*Family Brachionæa.* The genera of this family are separated into two groups, depending upon the presence or absence of eye-spots; in this species there is one eye-spot, hence it belongs to either *Brachionus*, or *Anuræa*, but as the species of the former have a forked foot, while this species has no foot, it belongs to the latter genus *Anuræa.*

ANURÆA LONGISPINA. *The Long-Spined Anuræa.* Lorica ovate-cuneate, smooth on both the dorsal and ventral surfaces; it has seven frontal and one terminal spine; the frontal spine situate on the middle of the upper margin is about twice as long as the carapace; seen from above it is straight, from side arched; those at the angles are equal in length to the carapace, curved outwards and downwards; there is a short one on either side of the long central one; also two short ones on the margin of the ventral surface; they seem to form ribs, nearly to the middle, designed to strengthen the ventral plate of the lorica, so that it opens and shuts the front by a hinge-like motion at the middle, similar to the lower shell of a Box Turtle; the terminal spine is somewhat longer than the lorica, straight seen from above, cynosuric in side view. The three long frontal spines when highly magnified, always appear rough, like the surface of the carapace of *Ceratium longicorne;* the terminal one is always smooth.

The buccal funnel situated in the lower middle part of the face between the trochal lobes is deep and ciliated; on its upper border is a projecting conical lip well ciliated; these cilia seem to be able to close over the mouth to aid in the retention of the prey. The mallei and incus of the mastax are easily made out, and are of the typical form. Oesophagus short, digestive cavity clearly divided into a capacious gastric expansion, and an intestine, or cloaca. The two glands, one on either side of the œsophagus, are distinct, round in one aspect, oblong in another.

Eye large, round, red.

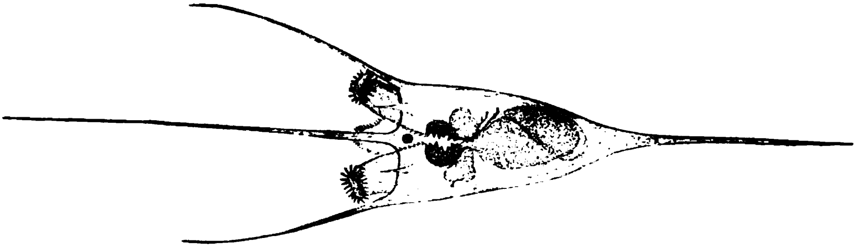
Egg attached.

Length, including the spines, 1-40 of an inch; length of lorica, 1-170 of an inch.

The male unknown.

Mr. Henry Mills, of this city, first called my attention to this rotifer; a sketch of it occurs in his notebook as early as October, 1874. I have found them at all times since. It appears from my notes that they are more abundant in autumn and winter than at other times. Like others of the family, the female carries under the posterior part of the body her unreasonably large ovum, shaped like an old-fashioned hen's egg.

This rotifer's case is so transparent that it affords a good example for the study of its structure, besides when under the compressorium its horns hold it in place, so it may be studied while alive with high powers. I have observed once or twice this curious variation of the spines; while it is the middle frontal one that usually develops to such great length, it is not always so, but instead its neighbor to the right pushes out to the usual proportions, at the same time it remains minute. On the whole it is in details as interesting as it is beautiful in outline.



A NEW ROTIFER.

If one is inclined to see an example of mimicry in every case of real or fancied resemblance, and upon no other evidence, it would be quite natural to point out that it mimics, or is mimicked by, the spined flagellate infusorium *Ceratium longicorne*, which at times abound in the Niagara water together with it.

Volvox Globator.

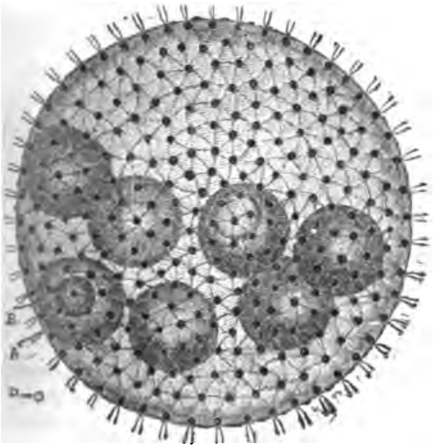
A RECENT English writer tells us that the most popular objects amongst the amateur microscopists of his country are the *Volvox globator* and the *Conochilus*, and there can be no question that they deserve all the attention that has been bestowed upon them. Fortunately they are both found in the ponds of this country, so that we feel certain that our readers who will carefully seek for them will be pretty sure to find them. During the past few years, the life-history of the *Volvox* has been very carefully and thoroughly worked out, and those who desire to study it will find a very excellent article by Prof. Alfred W. Bennett, in a recent number of the AMERICAN JOURNAL OF MICROSCOPY.

When first discovered by Leeuwenhoek, about two hundred years ago, it was regarded as an animal, and even now the uneducated observer can hardly believe that it is a vegetable. Such it is, however, despite its power of locomotion, and its very peculiar and beautiful form. The reader must bear in mind that there are many minute plants that have the power of moving through the water in which they live—some of them with considerable speed.

The usual appearance of the *Volvox* is very well shown in our engraving. Under a moderate power, it appears as a pale green globe covered with dots, from each of which proceed two cilia, and it is the motion of these cilia that cause the globes to roll through the water. In the interior of the *Volvox* may be seen from two to twenty smaller globes, and sometimes these small globes contain others still more minute. After a time the small globes escape from the parent globe, and pursue an independent existence, after which the parent dies.

It is not many years since the *Volvox* was considered quite a rarity in this country.

and many good microscopists believed that it was not to be found in American waters. The writer has a distinct impression that he was told by the late Dr. Goadby, who was quite familiar with it in England, and had traveled extensively in this country, that he had never met the *Volvox* in America, and yet Goadby was quite familiar with the microscopic inhabitants of our ponds. At any rate it is but a few years since the writer himself first saw it and published the fact, but since that time it has been frequently discovered in localities in which it was not supposed to have been previously found. It must be remembered, however, that the *Volvox* is very apt to escape the observation of those who are not familiar with it, and yet, like the well-known puzzle pictures, when once seen it is ever afterwards quite obvious when present. Evidence of the truth of this statement is found in the fact that while the ponds around London have always been famous for *Volvox*, Baker, at the time of writing the first edition of his book, "Employment for the Microscope," (1753) had never found them himself, and wrote his description from specimens accidentally found in water sent to him from Yarmouth by a friend.



VOLVOX GLOBATOR.

The *Volvox* is generally found in clear still water, free from such filth as sewage and decaying animal matter. The clear, open spaces amongst water plants are always likely places. We have found it in ponds densely shaded by trees, and also in those that were entirely exposed.

In searching for the *Volvox* and similar organisms, we have found the best instrument to be a clean homœopathic phial of good size—say half an ounce. Such a phial may be fastened to the end of a cane by means of the cheap little device shown on page 131 of "How to Use the Microscope." A "dip" may then be taken from any clear pool, the bottle removed from its holder, wiped dry on the outside, and examined with a half-inch lens. The *Volvox*, if present, will be seen as a pale-green globe, rolling about in the water and having little specks in its inside. In order to cause all the water to pass before the lens, it is well to give the bottle a slight whirl.

Under a power of twenty-five to fifty diameters, such as can be had from any cheap microscope, the *Volvox* presents a most beautiful and interesting appearance. To examine its ultimate structure requires good instruments, but its general form and its beautiful movements may be seen by means of a little French stand costing $2.50.—*Young Scientist.*

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Sizes of Gun Punches.

GUN PUNCHES are an important part of the microscopist's outfit, as they are in constant use for making cells, punching holes in covers, etc. As they are marked by numbers, not sizes, those who wish to purchase a punch of a certain size, frequently find it inconvenient to determine its exact diameter from its number. At the request of a subscriber, we publish the following table taken from "Shooting on the Wing."*

TABLE GIVING THE SIZES OF THE VARIOUS GAUGES OF PUNCHES AND GUN-BARRELS.

No. of Gauge.	Diam. of Bore in inches.	No. of Gauge.	Diam. of Bore in inches.
1.	1 669	19.	.626
2.	1.325	20.	.615
3.	1.157	21.	.605
4.	1.052	22.	.596
5.	.976	23.	.587
6.	.919	24.	.579
7.	.873	25.	.571
8.	.835	26.	.563
9.	.803	27.	.556
10.	.775	28.	.550
11.	.751	29.	.543
12.	.729	30.	.537
13.	.710	31.	.531
14.	.693	32.	.526
15.	677	33.	.520
16.	.662	34.	.515
17.	.650	35.	.510
18.	.637	36.	.506

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* *Plain Directions for Acquiring the Art of Shooting on the Wing.* With useful Hints concerning all that relates to Guns and Shooting, and particularly in regard to the Art of Loading so as to Kill. By an old Gamekeeper. New York: Industrial Publication Co.

THE AMERICAN

Journal of Microscopy,

AND

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The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

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J. G. LANGGUTH, Optician, 48 Madison St., Chicago, Ill.
JAMES W. QUEEN & CO., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, every letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change

Tolles' 1-75th Objective.

AT a recent meeting of the New York Academy of Sciences, Dr. Ephraim Cutter, of Boston, read a paper on the 1-75th inch objective by Tolles. This and the 1-50th were shown, and work done by them exhibited. The general impression amongst those present seemed to be that for first-class work objectives of much longer focus are far more efficient. The objective shown by Dr. Cutter, however, has a deep historical interest, and we hope to give a fuller account of it in our next issue.

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Trichina.

THIS subject has recently attracted a good deal of attention, both in this country and Europe. A short time ago, Prof. Richard Heschel, the Viennese pathologist, gave a warning in the Medical *Wochenschrift* to the consumers of foreign ham and bacon. He referred particularly to American hams, which were coming rapidly into favor, and had been loudly extolled, at the expense of Westphalian hams, for their freedom from trichina. Dr. Heschel says, however, that while among 2,000 or 2,500 Westphalian hams one is infected, of the American hams inspected in North Germany, according to an official report, one in from five to ten is condemned, and adds that there is great probability that several epidemics have been caused by trichinosis from American hams.

The report of Messrs. Atwood and Belfield, which we reproduce in another column, shows that trichinæ are much more generally distributed in this country than has been hitherto supposed. We feel certain, however, that both in this country and in Europe trichinæ are much more commonly present in the human subject than most persons have any idea of. It would not surprise us to find that ten per cent of the inhabitants of New York harbor this parasite in their persons, and this without ever having suffered any bad effects from it.

But while we agree with Mr. Atwood and

Dr. Belfield that it is not best to be easily frightened upon this subject, we also feel that too much care cannot be exercised in regard to the matter. It is not improbable that certain persons might eat with impunity an amount of trichinous meat which would prove fatal to others. The more thoroughly this parasite is stamped out the better, and we believe that a thorough knowledge of its life-history would enable us to do this. We shall take an early opportunity to return to the subject.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Dec. 5.

Mr. H. G. Hanks, referring to a mineral specimen exhibited by him a year ago, stated that it is determined by A. Michel Levy, M. E., of Paris, to be composed of glaucophane, smaragdite and garnet. The specimen was found near the "Wall Street Mine," Lake County, Cal., in serpentine, and is abundant in California, though heretofore it has been known to exist nowhere but at the Island of Syra, Grecian Archipelago, where it occurs in mica schist. A description may be found in Rosenbush's Mineralogy. Mr. Hanks also exhibited a section of andalusite, stating that the impurities forming the regular figures characteristic of that mineral are discovered to be magnetite.

Mr. William Ashburner read for Mr. Chas. Stodder, of Boston, a paper on "Diatomaceæ from Santa Monica, Cal.," which will be found on another page of this journal.

The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Dec. 19, 1878, Prof. Ashburner in the Chair, *pro tem.* Four new corresponding members were elected—Mr. Charles Stodder, of Boston; Prof. F. A. P. Barnard, of New York; Mr. A. Michel Levy, of Paris; and Mr. Julien Deby, C. E., of London.

Dr. S. W. Dennis presented to the Society three slides, prepared by Dr. R. H. Piper, of Chicago, under Dr. Dennis' eyes, to illustrate the effect of rattlesnake poison on the blood corpuscles. The first slide exhibited normal pigeon blood; the second the blood of a pigeon 41 minutes after being bitten by a rattlesnake; the third, blood of this poisoned pigeon the same after death. Dr. Dennis stated that he simply wished to vouch for the correctness of the experiment, not for Dr. Piper's theoretical claims.

A letter was read from Mr. Thomas P. Woodward, stating that the piece of diatom earth found by him in March, 1876, and from which the celebrated Santa Monica slides have been prepared, was discovered in the tidal refuse, with rounded edges, apparently left by the waves at high water mark. The locality was a couple of miles to the southeast of the lagoon, which is several miles southeast of Santa Monica, and there were no evidences of any other diatom earth in the vicinity.

Mr. Charles Stodder, writing to the Society about the Zeiss oil immersion, stated that Mr. Tolles had a 1-25th that works dry, water immersion, glycerine immersion, and oil immersion!

The Secretary announced that in the report of the meeting held November 7, 1878, a correction should be made. The photograph of Amphipleura pellucida exhibited was taken, not by Mr. Tolles, but by Mr. Woodward, with Tolles objective—1-10th glycerine immersion.

The Society adjourned at 10 P. M.

Buffalo Microscopical Club.—This Club held its regular January meeting, Tuesday evening, Jan. 14, at the Grosvenor Library.

Prof. Poole presented some experimental notes on the microscopical examination of milk, with special reference to that supplied by the city dealers, in comparison with milk of standard purity and richness—the peculiarities of each being shown by enlarged drawings of the microscopical appearances. The interesting points presented were largely discussed by the members present.

Dr. W. C. Barrett read a paper historical and technical, discussing the relative merits of the different systems of weights and measures in use in England, France and the United States, with special reference to the proposed establishment by those interested of an international standard of micrometry. The paper was introductory to the following report of the committee on this subject, appointed at the last meeting to give expression of the views of the club:

REPORT OF THE COMMITTEE.

Query 1st—Is it expedient to adopt a standard for micrometry? Answer—Yes; if the co-operation of the scientific world can be obtained. But as science takes no cognizance of boundary lines, it is not expedient that any single country or nationality should assume to adopt any unit, which shall be local in its use, as tending towards a greater confusion than now exists. It is, however, expedient that every scientific body shall do all in its power to secure one unit of measurement for the whole world.

Query 2d—If so, should the English or metric system be employed? Answer—Beyond all question the metric.

Query 3d—What unit within the system is most eligible? Answer—This is comparatively of little moment; but in our opinion the millimetre is most desirable.

Query 4th—What steps should be taken to obtain a suitable standard measure of this unit? Answer—The appointment of a committee on the part of the American Society of Microscopists, to correspond with and endeavor to secure the co-operation of scientific bodies throughout the world, to the acceptance of the millimetre as the unit.

Query 5th—How can this standard micrometer be best preserved, and made useful to parties concerned? Answer—If this question refers to recognized standard of rulings, they should be done under the supervision of committees of experts, to be agreed upon, and the standards then deposited in that institution for the fostering of scientific interest, which may have in each country the highest acknowledged standing—as for instance the British Museum, the French Academy, and the Smithsonian Institute. From these standards, verified copies could be obtained for the use of individuals or societies.

Respectfully submitted,
George Fell,
James W. Ward,
W. C. Barrett,
Committee.

On motion the report was adopted.

Mr. H. Mills reported the discovery, by himself and other members of the club, in the Buffalo pond waters, of the larva of *Corethra plumicornis*, of the family culecidæ. Mr. Mills described at length the microscopic features of the larva, remarking that owing to its delicacy and transparency, it showed with very little difficulty of manipulation, the whole internal structure of a very fine specimen of animal life.

Several members presented memoranda of personal work during the month: Dr. MacPherson of certain peculiar forms of carcenomatous cells clinically observed; Mr. Mills of some successful sections of the Medulla oblongata, by himself; Mr. Ward of fungus growths on dry mounts, apparently tightly covered.

Mr. Fell exhibited a new substantial turn-table, by Mr. Bulloch.

Jas. W. Ward, Secretary.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. Exchanges only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

I have for exchange a Kinne self-centering turntable with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypeus, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod, and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¼ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 243, Greenport, Suffolk County, N. Y.

Wanted, a human skeleton, articulated or non-articulated, in exchange for books, microscope, etc. E. Riedel, 318 East Fifty-third street, New York.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.

Wanted, a microscope, objective, or accessory apparatus, in exchange for a first-class guitar, Wm. B. Tilton's patent; cost $40. H. B., Box 852, Worcester, Mass.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

VOL. IV. NEW YORK, FEBRUARY, 1879. No. 2.

Knives for Cutting Sections.

SUCCESS in many departments of microscopical research depends so completely upon the ability of the student to make good sections, that the announcement of a work which gives the results of an extensive experience in this direction must at once attract the attention of a very large number of students and workers. The work recently published by Dr. Marsh,* in England, is of this character; it is simple and thorough—giving in a clear and easily understood manner directions for the most minute details.

To the American edition there has been added an appendix giving very complete information upon a subject concerning which very little that is practically useful is to be found in the language. We refer to the art of sharpening knives and razors, and as this is a matter in which almost all our readers are interested, we give the following extract from the most practical part of the appendix referred to:

For common work, good razors are as good as anything, provided they can be obtained with straight edges. Where razors are not suitable, recourse must be had to the surgical instrument maker, though we are sorry to say that there are but few in this country that know how to forge, temper and grind a decent knife. Most of our dealers in instruments do not make the instruments they sell; they import the goods they sell with their names stamped on, and thus get a reputation as manufacturers; a special order they are unable to fill respectably. There are some exceptions, but of the majority of dealers what we have written above is true.

The points which specially demand attention in a knife for cutting sections are these: 1. Quality of the steel used; 2. Temper; 3. Form of the blade.

Of the quality of the material of which a knife is made, nothing can be determined except by actual trial. The old tests of staining with acids, examining with the microscope, etc., are worthless, or at least too crude and uncertain to be of any practical value. Color changes with the degree of polish that is produced, and, in short, there is no reliable guide. The purchaser must depend entirely upon the reputation of the manufacturer. There is plenty of

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***A Practical Guide to the Preparation and Mounting of Sections for the Microscope;* Special Prominence being given to the Subject of Animal Sections. By Sylvester Marsh. Reprinted from the London edition. With illustrations and Notes by the American editor. New York: Industrial Publication Company.

good steel to be found; the trouble lies with the cutlers. They are careless and in haste, and as a consequence they burn the steel or fail to work it sufficiently, and the result is a useless tool.

The steel may be of the very best quality, however, and well forged, and yet the knife may fail from being badly tempered—too soft or too hard. If too soft, the edge is soon dulled; the knife requires to be frequently honed, and the time wasted in keeping it in order is a serious drawback. If too hard it is impossible to give it a keen edge, for the metal crumbles away as soon as it is honed or stropped very thin, and the edge becomes ragged and dull. Good steel, well forged, may be so tempered that it will neither crumble nor become rapidly dull.

Much may be learned on this point from careful inspection of the edge, and trial on a piece of horn, such as an old razor handle. When drawn over a clean piece of horn once or twice, the edge of a soft knife is completely dulled; if well tempered it should scarcely lose its keenness. Again, when laid flat on the thumb nail and pressed, the edge ought to bend up without breaking or crumbling, and at once, when the pressure is removed, resume its original shape. The extent to which extreme hardness or durability, and toughness may be combined, is well shown in the famous Toledo sword blades. One of these blades will shear through an iron nail without having its edge perceptibly dulled, and yet so tough and springy is it that it may be coiled up into a hoop of several folds without breaking or receiving any permanent set. If we could only get section knives of stuff like this, it would be a pleasure to work with them.

After all, however, the only test of these two points, material and temper, is a fair trial in actual practice. Of the form of the blade, however, it is easy to judge, and there are a few points which are frequently overlooked, and which give rise to errors that are attributed to other causes.

In the text we are told that "It is essentially necessary that the back and edge of the blade be strictly parallel to each other." The author undoubtedly knew what the correct form should be, but the definition he has given is not a correct mathematical statement of the conditions involved. These are as follows:

The edge must form a straight line, and both the edge and the under side of the back must lie in the same plane.

Let us consider these conditions somewhat carefully.

Since the hole in which the material to be cut is imbedded is always circular, and since the blade is generally pressed forcibly against the table of the microtome, it is obvious that if the edge of the knife be curved it will sink into the hole to a greater or less depth, according as it is further from the centre of the hole or nearer to it. To explain this, let us refer to the greatly exaggerated drawing given in Fig. 1, where the edge of the knife, *a*, *b*, is shown in two different positions covering the hole of the microtome. The least degree of reflection will show that as the knife passes towards the centre, from *a b*, to *a b*, it will have a tendency to turn on the back as on a hinge, and the middle of the edge will sink deeper into the hole as it approaches the centre of the latter. The section will therefore vary in thickness and prove useless. This difficulty can be obviated only by the use of a straight edge like *e*, *f*, which will always lie in the same plane.

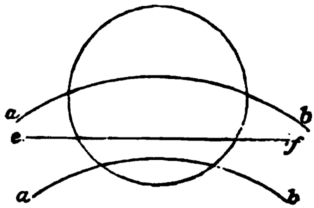

Fig. 1.

If the knife were perfectly rigid, and the curved edge and back lay entirely in the same plane, this difficulty would not occur to such a great extent. But since a curved edge rarely lies wholly in the plane of the back of the knife, and since the blades of most knives, especially those thin ones used for cutting sections of soft tissues, yield a little to pressure, and since this pressure is never exactly the same, it is impossible to prevent irregularities from occurring.

While it is not necessary that the back of the knife and the cutting edge should be parallel to each other, it is absolutely necessary that they be in the same plane, or, as mechanics say, "out of wind." If this condition be not observed, the blade will rock on the microtome table as it passes over it, and irregularity in thickness of section will result.

A slight knowledge of geometry will enable any one to see that these statements are strictly accurate.

As regards other points in the form of the knife, we refer to what has been previously said when discussing the general principles which should govern the construction of cutting tools.

We now proceed to give a few practical directions for sharpening knives and razors and keeping them in order.

Section knives, during the process of sharpening, are subjected to three distinct processes: 1. Grinding; 2. Honing; 3. Stropping.

Grinding is one of the most important, though it is probable that it will rarely be undertaken by the microscopist himself. More knives and razors are spoiled in grinding than in any other way. We have now in our possession an excellent knife which in an evil hour we entrusted to a New York cutler, and received it back utterly ruined, the temper being entirely taken out of the blades! Some of our readers may wonder at this, but unfortunately it is too true. The cutler, to save time and trouble, too frequently holds the blade against the stone with such force that it becomes over-heated, especially when he is a little careless, and allows the supply of water to fall short.* The owner does not find this out until he discovers that the knife is ruined, because nothing is more easy than to cool the blade and grind off the tell-tale blue spots. When charged with his rascality, the cutler always denies it and lays the blame on a "soft spot in the steel"—a miserable subterfuge—too transparent to deceive the least experienced.

The only protection against this is either to entrust the knife to a man of known carefulness and integrity, or to stand over him while he does it. If the knife be ground under the owner's eye, no fear need be entertained, because it is easy to insist upon the use of plenty of water.

The grindstone used for section knives should be of fine grain, and it should run true and be very straight across the face, otherwise it will be impossible to grind the knife true, and this, as we have seen, is a necessity.

Every microscopist that expects to do much at cutting sections must learn to hone his own knife or razor. Of the various hones in use, the famous Turkey oilstone is said to be altogether the best. It is, however, very difficult to get it genuine and in sufficiently large pieces. We therefore use the German hone-slate—a softer, yellow stone, of wonderful fineness and cutting power. The ordinary whetstones are altogether too coarse, and as for artificial stones and strops, they may do for coarse work and common razors for *scraping*, but they will not do for knives used for section cutting. If any of our readers should be so fortunate as to possess a good, old-fashioned Turkey oilstone with a fair-sized surface, let them think much of it. It is invaluable. Years ago, when working on some investigations that required the use of very sharp knives, we were offered, by an old English carpenter, the use of a real Turkey stone. We have never since found anything that did its work so quickly and so well.

To merely mention the substitutes for Turkey oilstone would fill some pages. We therefore confine ourselves to the German hone. It is obtained from the slate mountains in the neighborhood of Ratisbon, where it occurs in the form of a yellow vein running vertically into the blue slate, sometimes not more than an inch in thickness, and varying from twelve to eighteen inches. After being quarried it is sawed into thin slabs, which are usually cemented to a similar slab of the blue slate as a support, and the combined stones are then set in a wooden frame and fitted with a cover also of wood. Unlike the Turkey oilstone, the Arkansas stone and some others, the German hone is soft and easily scratched and worn. It must therefore be carefully preserved, and as the *flatness* of the hone is an important point, it should never be used for anything but section knives.

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*Nothing is more easy than to heat a thin rod or stout wire red hot by holding it against a dry grindstone rapidly revolving. We have often kindled fire in this way.

Having purchased a hone, the first thing to do is to see that it is perfectly true; that is, that its surface is a perfect plane. If hollow or twisted, it is useless until made straight. It may be tested by means of two steel or wood straight-edges, and the method of doing this, which is very simple but difficult to describe, the microscopist can learn from any cabinet-maker or carpenter. If the hone be not true, it must be made so, and this is best done by grinding it with emery on a slab of marble, or, better still, a plate of cast iron which has been planed true. (Waste castings with planed surfaces may be found in most machine shops, and may be either borrowed or purchased for a small sum.) . If the hone is very uneven, coarse emery may be used at first; then finer must be taken, and so on until the surface of the hone is not only true but very smooth. This involves considerable labor, but it cannot be avoided if a *true* edge as well as a sharp one is desired, and hence our advice to use the hone for nothing but section knives. Accuracy in a penknife or a razor for shaving is of no consequence; in a section knife it is a *sine qua non*.

The surface of the hone must not only be true and smooth, it must also be clean and free from dust and grit, a single particle of which may spoil the work of hours. It should, therefore, when not in use, be kept constantly covered. It is always used with oil, and this oil should be of a kind that does not readily dry up. Good sperm is excellent, and so is purified neats-foot oil. Avoid kerosene, soap and water and similar fluids which are so frequently recommended, especially under the guise of new discoveries. They have all been tried and found wanting. After use the stone should be carefully wiped clean, fresh oil being applied when it is next used. It must never be used without a liberal supply of oil, otherwise it will become glazed and will no longer act on the steel.

The hone being in good order, the blade is laid flat on it and moved over its surface with circular sweeps. The method of doing this is easily acquired, and is best learned by watching an expert cutler at work. If we could only hit it, the perfection of this operation would be to wear down the sides of the blade until they just met; they would then form a keen and perfect edge. Unfortunately we cannot always hit this point exactly; we are apt to overdo the matter just a little, and then comes up the *bête noir* of beginners—the "wire edge." This is caused by the metal of the blade bending away from the hone as soon as it becomes of a certain degree of thinness. Once it does this it cannot be worn off by the hone, and the only way to remove it is to draw the edge of the knife or razor across a piece of horn or hard wood. After removing the wire edge in this way, give the blade one or two sweeps on the hone and then strop it. If the blade be very soft, the wire edge comes very quickly and easily, and is very hard to get rid of. On very hard blades the wire edge is not so apt to make its appearance. It comes, however, on very excellent blades. It may be avoided in a measure by driving the blade edge-first over the hone, and indeed the blade should always be sharpened most in this way. And since the backward and forward strokes are always nearly equal, as regards space passed over, this is accomplished by exerting a greater pressure on the forward than on the backward stroke.

This wire edge is a nasty thing when it breaks off on the hone. Unless removed it will very speedily ruin a fine knife; therefore look out for it, and wipe off the hone carefully if you have any suspicion that particles of steel have broken off the blade and got on to it.

In honing, as in everything else, however, nothing but practice will impart skill, and he who intends to become an expert should practice on a few old razors, grinding, honing and stropping them himself until he has acquired the art of giving them an edge far keener than most of the razors ordinarily used for shaving.

The last operation to which the knife is subjected is that of stropping, and as the blade should be stropped after every section, it becomes important that our tools should be good, and that we should know how to use them. By having two or three knives we can always avoid grinding and honing the blades ourselves, for it is then easy to hire the work done, and half-a-dozen knives will last a careful worker a long time with merely the aid of a good strop. But the strop he must use himself. Fortunately no great skill is required in stropping, but the strop must be a good one, and is best home-made.

Our readers have doubtless seen the "Cheap John" strop-vendors take a rough table knife, strop it on one of their "patent" strops and cut a hair with it. Nevertheless such a knife, sharpened in that way, would not cut good sections, and such a strop is not just the thing for giving the finishing touch to a section knife, even though the label does say that it is "intended for surgical instruments." *

The strop should never be used with the intention of removing metal so as to thin the edge of the knife. This is the proper function of the hone, and those who depend most on the hone and least on the strop, will always succeed best. The strop is used in the first place for *smoothing* off the edge, and in the second for removing that incipient dullness which always comes from even the slightest use. It is true that in the latter case the strop trespasses somewhat on the functions of the hone, but only to a very slight extent, and stropping should never be carried so far as to require more than a very few strokes.'

The best material for a strop is good calfskin, well tanned, and firmly glued to a strip of wood with the hair side out. The leather should be hard, otherwise it will rapidly round the edge of the knife. The way in which this occurs is readily understood from Figs. 2 and 3. In Fig. 3 the leather is seen to rise up behind the edge of the blade as the latter passes over it, so that instead of two plane facets meeting at an angle of from 15° to 20° as left from the hone, (Fig. 2) the edge has become considerably rounded, and the ultimate angle of the cutting edge is nearly or quite doubled. The hardest and firmest leather should therefore be chosen, avoiding of course any leather that has been made hard and unpliable by the action of water or other agents. Two sides will be found enough for a strop. On one the leather should be kept clean, while the other should be thoroughly impregnated with fine grained, but very hard

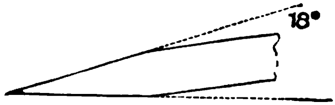

Fig. 2.

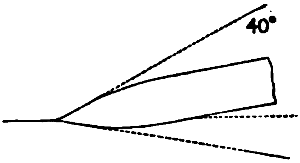

Fig. 3.

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*The finest emery paper, glued on a strip of wood and used as a strop, will impart to a razor an edge sufficiently keen to enable it to remove the beard, and if paper three or four degrees coarser be used, a very dull knife or razor may be sharpened, and afterwards stropped on the finer emery, until it is keen enough to cut a hair. But it will be found that cutting edges produced in this way are not smooth enough for section-cutting.

rouge or crocus.* Rouge is an artificial oxide of iron, prepared by exposing sulphate of iron to heat. The hardness of the resulting powder depends upon the temperature to which it has been exposed, and this temperature is very well indicated by the color which the rouge assumes. Bright red or crimson rouge is soft and will not cut steel; hard rouge, suitable for polishing steel, is purple in color, and this quality should therefore be chosen. Great care should be taken to see that it is free from gritty particles, and it should be well rubbed into the leather in a dry state. All mixtures of grease and oil with abrasive substances should be eschewed. If the leather be of good texture, and the rouge hard and fine, a very few strokes will suffice to impart the last degree of smoothness and keenness to the blade.

Since grit and dust would soon spoil the strop, it should be kept carefully covered and protected. The rouge will require occasional renewing, which may be done by sprinkling a little lightly over the surface and rubbing it in with the finger. Consequently we find that the best and most convenient holder for rouge is a bottle with some fine but porous fabric tied over the mouth of it, forming as it were a sort of dredge. Over the bottle mouth and its cover should be tied a paper cap to keep out dust.

We have thus endeavored to give, in as simple a manner as possible, such information as will guide the microscopist to the acquisition of skill in this most important but generally despised department of his art. We are told by the biographer of Swammerdam that a great deal of his success was to be attributed to his skill in sharpening his fine knives and scissors. The same is also stated of other noted workers, and yet none give even the slightest directions to the novice who desires to follow in their footsteps. There is not, to our knowledge, a single book in the English language which treats fully of this subject, with perhaps the exception of Holtzapffel's work on "Mechanical Manipulation," and this has long been out of print. As previously stated, however, it is only by practice that the necessary finger-skill can be acquired, but this skill is well worth acquiring at any cost. The man who depends upon cutlers and knife grinders will never make satisfactory progress.

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Experiments with Pyrethreum Roseum in Killing Insects.

BY W. L. CARPENTER, U. S. A.

IN the August number of the *American Naturalist* appeared an article on the carpet-beetle, by J. A. Lintner, in which the statement was made, as nearly as I can now remember, that "although he had never used *Pyrethreum roseum* as an insect exterminator, he had no doubt that it would prove unavailing if applied to the destruction of the *Anthrenus*." As it seemed unfair to condemn without a trial what is generally regarded as a useful insect poison, I resolved to test it experimentally; and now present the result of several trials with different orders of insects.

The insects were placed under a tumbler, which was slightly raised to admit fresh air, and a small quantity of the *Pyrethreum roseum*, or Persian insect powder of commerce, introduced on the point of a penknife. The movements of the insects brought them in contact with the powder, which readily adhered to the body; in attempting to remove it from their appendages a few particles would be carried to the mouth and thus incorporated in the juices of the stomach with fatal effect.

A honey-bee became perfectly helpless in fifteen minutes, a mud-wasp in eight minutes, a small species of ant in five minutes; a small species of *Pyralidæ* became helpless in twenty minutes; the large *Papilio asterias* resisted the effects of the drug for over one hour, and upon being released seemed to recover, but died next day. A larva of one of the *Noctuælitæ* did not seem susceptible, its jaws were repeatedly filled with the powder, which it invariably ejected by throwing out its juices; at the end of two hours it was still able to crawl feebly. A house-fly became helpless in ten minutes, a mosquito in fifteen minutes, a flea in three minutes.

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*Rouge may be purchased from dealers in watchmakers' tools. Those who cannot procure it readily may very easily prepare it for themselves. Full directions may be found in the "Amateur's Handbook." New York: Industrial Publication Company.

In experimenting upon the *Coleoptera*, an insect as nearly the size of the carpet-beetle as could be found was secured in *Diabrotica duodecim-punctata*, an abundant species here. It was easily affected, and became helpless in twelve minutes. A small pinch placed in the jaws of a large *Carabus* stopped locomotion in thirty minutes. The *Hemiptera*, owing to their peculiarly shaped mouths, were enabled to vigorously resist the baleful influence. A species of *Coreus* was active at the end of two hours, but was ultimately overcome. A large sized katydid was deprived of motion at the end of ten minutes; *Caloptenus spretus* likewise in eighteen minutes. A dragon-fly (*Libellulidæ*) died in one hour. Spiders succumbed in one hour and fifteen miutes. The scent from the powder did not produce any bad effect upon insects subjected to its odor where actual contact was not possible. But when carried to the maxillæ or mandibles, the effect is to produce complete paralysis of the motor nerves. The legs are paralyzed in regular order, commencing with the first pair; insects will sometimes live for days in this condition, but death ultimately results from the introduction into the mouth of the smallest quantity. These experiments prove that all insects having open mouth parts are peculiarly susceptible to this powerful drug. And as a result, the writer does not hesitate to recommend the powder to housekeepers as an infallible agent in destroying the carpet-beetle and preventing its ravages. Twenty-five cents worth of powder liberally sprinkled upon the floor before putting down a carpet, and afterwards freely placed around the edges and never swept away, will suffice to preserve a large sized carpet. No ill effects from its use need be feared by the household, since if applied in this way it will be only poisonous to all kinds of insects.—*American Naturalist.*

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Examination of Powders—A New Employment for the Microscope.

THE value of many materials that are used in the arts depends very much upon the degree of fineness to which they are reduced to powder. This is usually judged by the sense of feeling—a little of the powder being rubbed between the fingers. In some cases the appearance of the powder as to color, and its behavior when laid in a little heap, and moved about with a knife or spatula, is a good guide. Most substances, when reduced to a very fine powder, behave like fluids in some respects and like solids in others. For example, they can be made into a heap with a perpendicular face, which cannot be done with sand, for example. (Try this with flour or with silica—sand very finely powdered). But the most accurate way of judging of the fineness of powders is by the microscope. Under a power of 100 diameters, most powders look coarse; 250 shows well some powders which are regarded as very fine, while there are no powders in market which do not appear coarse under a power of 500 or 600. The methods of examination will probably vary under different circumstances, but in any case, the operation is a very simple one.

In this case a doubling of the magnifying power more than doubles the efficiency of the microscope, for this is one of the few cases where areas and even cubical contents are of account. A fragment seen under a power of 100 will appear as large as a fragment that is not only 10,000 times, but 1,000,000 times as large, and under a power of 600 diameters, a fragment weighing the 1-10,000th part of a grain will appear as large as one which weighs over three pounds avoirdupois! This seems very astonishing, but a little calculation will readily show its accuracy, and points very strongly to a hitherto neglected but very important employment for the microscope.—*Young Scientist.*

On a Standard for Micrometry.

[*From advance sheets of the American Naturalist.*]

Remarks by R. H. Ward, M.D., at the Microscopical Section of the Troy Scientific Association, Dec. 2, 1878.

GENTLEMEN—When the subject of a standard for micrometry came before this society, at the suggestion of the late National Microscopical Congress, we found ourselves unable to vote satisfactorily upon it, not for want of any definite desire in respect to it, but because it seemed evident that a mere affirmative or negative answer to the proposals of the Congress would not accomplish any desired result. For a few individuals or societies to commit themselves positively either for or against those proposals, might even render valuable progress on this important subject more difficult. The differences of opinion were so strong and so reasonable, and the other interests involved were so diverse and widespread, as to call for a thorough conference before adopting any definite policy. We therefore suggested a national committee to investigate the subject, confer with persons wishing to be heard or likely to give valuable information in respect to it, and place the data thus obtained at the service of all parties interested. As yet we have heard of no opposition to the appointment of the proposed committee. The whole spirit of the world's science at the present day calls for the highest possible precision in determining questions of the form and size of objects. It is well known that such precision has not been attained in micrometry; and it is difficult to believe that any one who desires to give a respectful hearing to the wishes of his fellow students, could seriously object to submitting this manifestly important subject to the consideration of a suitable committee. Whether in favor of one action, or of another, or of none, we should certainly be willing that all opinions and preferences be heard before making our final decision.

As to the course which should be adopted by the committee, or recommended to the country, there is, however, the greatest room for reasonable differences of opinion, and the same reasons which make a committee necessary, should require us to submit our views with candor and plainness, but without demanding or expecting that they shall be adopted as a whole. A fair hearing and a respectful consideration is all that can be asked by any one in such a case. And for the same reasons, any action taken by a committee, or by any society or group of societies, should be suggestive or advisory, and not positive or dictatorial.

There may even be some who believe that nothing useful can be accomplished in this field; but a second thought may show that much good can be effected, without doing anything of doubtful expediency. It seems unfortunate that in the suggestions of the Congress more prominence was given to those points in regard to which there is greatest difference of opinion, and most intelligent doubt as to what ought to be done, than to the more important want underlying them. What we need is precision, first, and afterwards uniformity of nomenclature if we can get it. The essential part, on which all should agree, is that statements of size and distance should have a definite meaning; that when an author mentions, for instance, the 1-1000th of an inch, or the 1-100th of a centimetre, or of a millimetre, that statement should mean one and the same thing to him, the writer, and to all intelligent readers. This certainly is not true in regard to the measurements made and recorded with the microscope in the past or at the present time. The best stage micrometers in use, as a basis for measurements, are well known to differ among themselves by various and easily measurable discrepancies which must represent errors on one side or both. In comparing micrometers from different sources, differences of two per cent have often been noticed, and sometimes as high as six per cent. Far less errors than these, and such as are quite generally present, must greatly impair the scientific value of all measurements; and it may be safely said that the exact degree of accuracy of the instruments used, and therefore of the measurements recorded, by observers with the microscope, is seldom known to the authors themselves, and scarcely ever to the readers of their papers. Nor can individual care and labor overcome this difficulty. A student can reject conspicuously bad ruling, and take the average of the best within reach; but cannot know, at last, exactly how well his best scale represents its nominal value. To determine how nearly the 1-100th of an inch on our glass plate corresponds to the 1-3600th of the standard yard in London, or of our national copy of that standard in Washington, is a most valuable result which can be attained only by concerted action, and is well worthy the labor of any committee or of any society. We need a tangible inch, whether called a standard or not, which should be, as nearly as can be determined by the modern microscope, or by any other known means, the 1-36th part of the standard yard; or a centimetre corresponding equally well with the 1-100th of the standard metre; or some other equally determined unit, which should be officially recognized as authority for all who desire the greatest attainable accuracy. If so accurate a subdivision exists among the national standards at Washington, it might be verified by the committee, and arrangements sought from those having it in charge by which it could be made practically useful to the microscopists of the country. If such a standard does not exist, one should be made; or if it is not within the power of our present art to give results in which the microscope cannot find a fault, then the end could be attained, measurably well, by selecting a standard as perfect as possible, and attaching to it a statement of its carefully determined errors,

This standard, if it be proper to call it a standard at all, should be selected by, or made for, the committee, should be the property of the nation, and should have no mercantile relations whatever. By means of a limited number of very carefully verified copies, which could be also used as a means of reconstruction in case of accidental destruction of the original, it could be rendered available to all persons who make or use micrometers. The cheapest commercial scales, even, could without increase of price be accompanied by a statement as to how closely the work of the screw which ruled them has been found to correspond with the standard; and all plates claiming a high degree of accuracy could be carefully compared, space for space, and accompanied by a statement of the ascertained error of each individual space. Persons of really scientific training would gladly incur the extra expense of such a corrected scale. Even a series of microscopical measurements already completed and published, might, in some cases, receive additional value by a note, added in later editions, stating how nearly the apparatus used by the author has been found to correspond with the standard afterwards adopted.

Of course this standard would deserve the name only in a limited sense, and not in the same sense as the standard yard in London, and the standard metre in Paris; but it would be an officially recognized representative of some unit practicable in microscopy, and it might be made to add greatly to the uniformity and value of our work.

The material of which the standard should be made, the form it should take, the manner in which the spaces should be indicated, the temperature at which it should be standard, and the manner in which it should be made available to the public, and in which its safety could be best secured, could only be determined after careful consideration of the world's recent experience in respect to the care and use of precise measures of length. It has even been debated whether the practical standard should be a ruled plate or a spacing screw for use in ruling plates. But as the work of a screw is known to vary considerably according to the conditions of its use, some of which conditions are not easily controlled, the adoption of a screw, however accurate it might be, would be likely to result in the dissemination of a number of ruled plates possessing equal authority as standards, but differing measurably from each other. Whether the micrometric standard should be taken from our national standard at Washington, which is itself a copy, or from the world's standard in Europe, and whether co-operation with other countries is feasible in this work, are important questions for consideration.

Whether the standard secured should be a fraction of the yard or of the metre, and how large a fraction, I, for one, should scarcely have an opinion until the committee should ascertain how generally each system is used by the workers of the country, and how freely those workers would be willing to adopt the new system by general agreement. Whichever system is adopted, many microscopists would be glad to have a convenient unit in the other system, verified by comparison; a standard centimetre divided into one hundred parts, for instance, being accompanied by an inch similarly divided, and having, microscopically, the same relation to it that it has mathematically. This method, of possessing a practical standard in each system, while technically improper, would be a convenience, and would give a great improvement in our micrometry. Nor would the objection that it might hinder the universal adoption of the scientific (metric) system be a serious difficulty to my mind. The adoption and rejection of systems is a matter of evolution, not artifice, and the world will move at a rate that depends upon its average interests, without being much affected by special efforts to advance or retard its progress.

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—Certain manufacturers of a cheap microscope advertise it as follows: "It will show the tubular structure of hair; also the much-talked-of *trichina spiralis*, or pork-worm, which has caused so much excitement and so many deaths, thus furnishing an endless source of amusement and instruction combined" !!

Microscopic Pond Life.

Paper read before the North Staffordshire (Eng.) Naturalists' Field Club, by Mr. T. S. Wilkins.

(Continued from page 17.)

WE will now pass on to examine bottle No. 2. We take up two or three radicles, and place them first in a large-sized trough. In the summer and autumn months of the year, you may almost invariably rely upon each one of these radicles being a mass of life. It may not, perhaps, be seen all at once; some little time is required to enable the creatures to recover their nerves—for such many of them undoubtedly possess—but colonies of Epistylis and Carchesium are pretty sure soon to reveal their presence, and an exquisite sight they are. Here, again, we have the cilia hard at work. While watching this, a little sugar-loaf-shaped tube begins to show signs of life, and probably after one or two peeps to see whether all is safe, the beautiful Melicerta Ringens makes her appearance. Here the cilia are much more developed; suddenly another tube, differing from the last in shape, is seen to open out, and discovers to us the Cephalosiphon Limnias, who carries his circlet of cilia some two-thirds of the way up that portion of the body visible above the tube. We examine different portions of the contents of the trough, and our astonishment increases the longer we gaze. Every fresh move of the trough brings up some new form of life. Here, perhaps, the beautiful Floscule, there Vaginicola Valvata and Crystallina, both veritable Jacks-in-boxes. Roaming about rapidly in every direction, propelled by the little wheels of cilia which each one bears, are numbers of the free swimming rotifers. In another part of the field we may possibly have a group of green Stentors. Indeed, the whole scene before us teems with life and beauty, and as some of the objects are of great interest, and have been the source of many learned discussions, we may very pleasantly spend a few moments in their more careful examination.

Turning again to the Melicerta, or the tube-building rotifer, as it is often called, a very cursory examination shows us that the sugar-loaf tube is built up of a number of reddish-colored pellets (in the common species perfectly round.) Of this tube the Melicerta is at once brickmaker, mason and architect.

Scarcely less interesting than the Melicerta, but I think far more beautiful, is the Floscularia Ornata—or beautiful Floscule—a rotifer of the same family as the Melicerta. As the creature itself is of the most delicate transparency, and lives in a tube almost equally transparent, and the entire animal is only some sixtieth of an inch in length, it is very easily passed over, and to be seen properly requires to be most carefully illuminated. It may be compared to a long tubular flower with a fine angled petal somewhat like that of a convolvulus, the tube swollen and contracted below the lip, and seated on the end of a long stalk. The name of Ornata was given to it in 1830 by Ehrenberg. The body is sub-oval, and above it is a neck or constriction. From this neck the beautiful flower-like disc opens, an expanse of the most exquisitely delicate and brilliantly transparent membrane, which forms five blunt points or nobs, equidistant and somewhat rising, and one of which, the dorsal one, is considerably higher than the rest. The most remarkable feature in the animal, and to which it owes much of its peculiar elegance, is that each knob is beset with straight bristles of exceeding slenderness and great length, not set in one alone, but radiate in all directions. There are some forty or fifty of these bristles in one knob. When the animal contracts, all the bristles are drawn parallel into a single pencil and concealed within the body, and this arrangement is well seen as they slowly protrude in the act of exertion. They are motionless when expanded, but while protruding (falling, as has been well said, on all sides in a graceful shower) the pencil is seen to be agitated with a close and rapid thrill or wave which runs along it. It ceases the instant the disc is expanded.

We must just look for a moment at the Polyzoa. They form a class of animals much more highly organized than any we have yet looked at. They are frequently to be found in such ponds as our No. 2. It is impossible for pen and pencil to describe the marvellous beauty of the Polyzoa when seen under good black-ground illumination. When first placed under the microscope, Plumatella presents nothing but a dirty-looking brown tube. When, however, all is quiet, the mouths of the bags belonging to each animal are slowly exerted, and out come a numerous bundle of tentacles, which generally spread like the corolla of a flower symmetrically expanded. The tentacles, each of which curves with a living grace, and displays an opaline tint in its glassy structure, do not form a complete circle, for at one place we discern two slightly diverging arms of the disc or frame—the lophophore—from which they grow. These arms support tentacles on each side, and leave a gap between, so that the whole pattern is crescentic, or crescent-shaped, not circular. Extending as far as the points of the arms, and carried all around the crescent, is an extremely delicate membrane, like the finest gauze, which unites all the tentacles by their hard portions, and makes an elegant retreating curve between every two. Each tentacle exhibits two rows of cilia which scintillate as their vibrations cause them to catch the light. The motion of the cilia is invariably down one side and up the other, the current being carried from one tentacle to the other, all through the series. This characteristic, and the facility with which each cilium can be distinguished, gives great interest and beauty to the spectacle of this wonderful apparatus. By it water currents are made to bathe the tentacles, assist respiration, and carry food towards the mouth, over which a sort of finger or tongue is stretched to guard the way and exercise some choice as to what particles shall be permitted to pass on. Very similar, only perhaps larger, and, if possible, still more beautiful, is the Lophopus Crystallinus. It is, however, not nearly so frequently met with as the Plumatella.

We have no time to notice the Cristatella Mucedo, which resembles the Lophopus somewhat. In such ponds as that numbered 2, I have found it in enormous quantities about Uttoxeter. To the naked eye, it looks nothing more than a string of jelly adhering to the stem of some submerged plant.—*English Mechanic.*

On Searching for Trichinæ.

BY GEO. W. MOREHOUSE.

IT is undeniable that microscopists waste a good deal of valuable time by the use of higher powers than are necessary, and by imperfect preparation of objects for examination. In nothing is this more forcibly illustrated than in the examination of pork for trichinæ. For this purpose it is customary to use powers of seventy-five diameters and upwards, (seldom as low as fifty), and the meat is not always made sufficiently transparent for ready detection of the parasites. The results are that time is lost by the use of too high a power, and many trichinæ doubtless escape observation. My own experience teaches me that a power of twenty-five diameters, obtained with a good two-inch objective, and two-inch ocular, is amply sufficient, and, indeed, a still lower power, will answer the purpose. With the two-inch we have greater depth of focus, the object is still shown with great clearness, and, most important of all, we are able to do as much searching in one hour as it would take about nine hours to accomplish with a two-thirds inch objective. It will at once be seen that the advantage in favor of the lower power is very great.

As to preparing pork for present, rapid and accurate observation, I have found the following method to work well: Cut thin longitudinal sections from the extremities of muscles, and from other favorite localities where the worms, in migrating, stop in greatest abundance, and place the sections in a watch-glass, covering them with acetic acid, U. S. P. In a few minutes the tissues will be transparent enough to enable one to see the letters through the specimens when the watch-glass is placed on a printed page. Drain off the acid, add water and examine, or, wash and transfer to a glass slip (large, with large cover, for a number of sections at once,) either in water or glycerine, and cover. For permanent preservation, while the sections are still in glycerine, press them for several days between plates of glass, and mount at leisure in pure glycerine. When thus prepared, the parasites remain colored more highly than the surrounding muscular fibres, and readily attract the eye. They are so plain, that none, when brought into the field of view, can escape instant detection. The process is simple, takes but little time, and is inexpensive.

Wayland, N. Y.

Structure and Mode of Formation of the Giant Cells of Tubercle.

AFTER careful study and experiment, MM. Charcot and Gombault have come to the conclusion that the giant cell of tubercle is a multicellular nodule, and not as generally believed a single cellular element. When a giant cell is isolated from a tubercular nodule and brought under the microscope, it is seen to be covered on all sides with processes composed of a granular, refracting protoplasm, having a strong affinity for picric acid; the peripheral portion of the cell is occupied by numerous nuclei, while the central portion consists of a granular, refracting mass, which has a very characteristic appearance. Light tapping on the covering glass causes the separation from the mass of the cell of a certain number of cellular bodies, each of which contains one or more nuclei and carries off some of the peripheral processes just spoken of. Other bodies exactly similar to these are only partially separated from the giant cell. The former are evidently epitheloid cells, which have been closely united with the giant cell, while the latter only differ from them in the fact that their connection with the giant cell is still more intimate.

In the nuclear zone of the giant cell the lines of junction of these cellular bodies can often be distinctly perceived, but they disappear entirely in the central granular mass. If the tapping be carried on further, the giant cell is sometimes resolved into a number of smaller masses, each containing several nuclei, and evidently cellular in its structure.

Sections of the giant cells furnished some important information. Three successive cuts of the same cell, which is taken as an example, presented the following appearances: No. 1 presented a true multinuclear plaque. In the centre of the plaque the nuclei were crowded closely together, but towards the periphery they become more and more sparse. From the periphery extended in all directions a crowd of processes with thick bases and attenuated apices, which were lost in the surrounding tissue. No. 2 presented the giant cell with what may be called its classical characters: centre granular, refracting and structureless; outside of this a zone of nuclei; beyond this still very numerous processes radiating in all directions. In one place the zone of nuclei was interrupted for a certain space, and at a point corresponding to this hiatus the processes were almost entirely wanting. This fact was taken as a fresh intimation of the intimate relations existing between the nuclei and the processes. No. 3 finally presented a small mass of cellules with brilliant protoplasm and indistinct contours; at the centre of the mass the cellules were grouped about a narrow opening which could be followed to a certain depth in the cut. The giant cell varied in size as well as in shape and constitution, in the different cuts. If the volume of the cell in cut No. 3 be taken as the unit of measure and represented by 1, its volume in the second cut would be represented by 3, and in the first by 2½.

MM. Charcot and Gombault think that the facts noted justify the following deductions: First of all, the giant cell tapers towards one, and perhaps both of its extremities. Second, both the pedicle and the peripheral zone of the dilated portion of the cell have a purely cellular structure, but in the latter region the elements have undergone a modification, as a result of which they are soldered together by a partial fusion of their protoplasms. The characters of this modification are most marked at the periphery; they consist in the swelling of the protoplasm, its granulated aspect, its tendency to fusion, its peculiarly refractive power, and its affinity for picric acid, to the exclusion of carmine. All these different changes, however, are also met with in other parts of the tubercular new-growth, and it is through them that the epithelioid zone of the tubercular follicle is produced. The cells lining the pulmonary alveoli, and the endothelium of vessels of a certain calibre, also undergo, under certain circumstances, a similar modification. The nature of this degeneration is unknown, but it may be designated by the term "vitreous transformation," and its effects, as MM. Charcot and Gombault believe, are analogous to what takes place in the peripheral zone of the giant cell. The cellular elements increase in size, the nuclei proliferate, and the protoplasm takes the above characters; then the cells fuse together in greater or less numbers, the lines of separation disappear, and thus structures are formed, resembling to some extent the giant cells. Moreover, it is known, that the ordinary end of this vitreous transformation is caseous degeneration, and the resemblance between the central caseous matter of a tubercular granulation and the central substance of a giant cell is very striking.

From these considerations our observers deduce the conclusion that the central mass of the giant cell had at one time the same cellular structure as has been demonstrated in its pedicle and its peripheral zone, the elements having undergone first an epithelioid transformation, and then caseous degeneration. Hence, it follows that the giant cell is not a single cellular element, but a multicellular nodule, at the centre of which the tubercular process has attained its limit of development.—*Gazette Medicale de Paris, Aug.* 24.

An Easy and Simple Method of Resolving the Finest-lined Balsamed Diatomaceous Tests by transmitted Lamplight, with special reference to Amphipleura pellucida.

BY ADOLF SCHULZE, GLASGOW.

Read before the Royal Microscopical Society, March 6, 1878.

THE resolution of the finest-lined tests, and especially of the markings of *Amphipleura pellucida*, is at all times a matter of some difficulty, and requires for its accomplishment the best objectives and the most careful arrangement of the illumination. It is generally assumed that the resolution of the closest markings on diatoms is far more difficult when they are mounted in balsam than when they are mounted dry, and with the ordinary means of illumination this appears to be indeed the case; but I purpose to describe a simple method by which even so small and closely striated specimens as Nos. 18, 19 and 20 on Möller's diatom probe-platte, and other still finer valves, having about 100,000 lines per inch, may be easily and unmistakably resolved into distinct striæ by lamplight, and which by sunlight yields so excellent results that I can only compare them to those admirable photographs of *Amphipleura pellucida* taken by Dr. Woodward. It must, however, be borne in mind that the ridges constituting the markings of these minute diatoms mounted in balsam, possess a minimum of substance, and being extremely transparent, cannot throw *black* shadows, such as those of the larger and coarser frustules, and that if the field were too brilliantly illuminated these infinitesimal shadows would be totally obliterated. Some people may be inclined to think that the markings shown as alternate *gray* and white lines are only faintly resolved; but microscopists whose eyes are cultured by observations on diatoms will readily admit such a resolution to be perfect, provided no spurious or colored lines make their appearance, and they will grant that this is all which can be expected to be seen under the most favorable circumstances.

The best dry achromatic condensers, and even Powell & Lealand's supplementary stage and small plano-convex condenser, fail, as far as I know, to aid in the resolution of balsamed specimens of *A. pellucida;* and those few observers who have succeeded on this difficult test by lamplight have not published any accounts of their modes of illumination.

In an article on the "Immersion Paraboloid and the Reflex Illuminator," which appeared in the *English Mechanic* of Dec. 7, 1877, Mr. F. H. Wenham claimed as one advantage of the latter over the former that it would give a dark ground on balsamed objects even when they were viewed with immersion lenses. This statement I cannot but consider as only partially correct; and I would like to divide immersion objectives according to their behavior with the reflex illuminator into three classes: 1st, those which give a dark ground; 2d, those which give a gray ground; and 3d, those wide-angled immersion lenses which are capable of giving a light ground, and which alone are suitable for the method I am about to describe.

Some time ago, while trying Wenham's reflex illuminator and Powell & Lealand's 1-8th new formula immersion lens by unmodified sunlight on Möller's probe-platte, I found on lowering the condenser that the field became brightly illuminated by a spectrum. I focussed for one of the larger diatoms, and found it bathed in spectral colors, which impinged on it very obliquely, and which brought out the markings very distinctly. Bringing successively the finest diatoms of the Platte, such as *Navicula crassinervis*, *Nitzschia curvula*, and *Amphipleura pellucida* in the field, I found all their cross markings revealed with wonderful distinctness, the last-named diatom appearing like a fine comb. These cross markings, for which I had been looking for years, and which had baffled all my efforts to show them, appeared now all at once distinct enough to be counted, and were entirely free from spurious and colored fringes. I then tried the so-called Edmund immersion paraboloid in the same way, and found that by its means similar but not so satisfactory results could be obtained. The secret of my success was that I had used castor oil instead of distilled water to unite the top of the reflex illuminator with the under side of the slide, and the former being a thicker fluid than the latter, allowed me to obtain that range for focussing the illuminator, which is necessary to obtain light ground. I then experimented with lamplight, and found that the more powerful the light the more distinct the striæ appeared, and that the Dallinger lamp gave the best results; but that even by the light of a lamp having a wick of only half an inch broad, the markings were plainly shown. The illumination obtained in this way, unmodified sunlight included, has the advantage of not being by any means intense enough to be painful to the eyes, and as required, any of the colors of the spectrum may be used without the slightest difficulty. The blue and violet rays are especially agreeable to the eye. The light becomes most dispersed when the narrow side of the wick is used, and when the rectangular prism is turned a little on its vertical axis, so that the rays do not fall quite perpendicularly on one of its sides.

Finally, I will give a few practical instructions for this method. I place the lamp to the left, and when using the ordinary form of Möller's probe-platte, or a slide having a balsamed valve of *A. pellucida* lying horizontally on it, I turn the reflex illuminator so that its polished-off face looks as it were to the right, the edge of the wick facing the mirror or rectangular prism at the tail-piece. After having racked up the reflex illuminator until its plane top is level with the stage, and after having centered the dot by means of a 2·3d-inch objective, I put a few drops of castor oil, or better, of glycerine, which is easier cleaned off by water, on the top of the illuminator, taking care that no air-bells are formed, and that none of the fluid flows down the polished-off face. I then illuminate as for dark ground, and focus for the object, generally first for one of the larger diatoms on the Platte, using of course one of those large-angled immersion lenses which I classed among No. 3. By lowering the reflex illuminator or the immersion paraboloid from the one-twentieth to the one-thirtieth of an inch, the ground becomes light, the red appearing to the right, and the blue of the spectrum to the left of the field. By a little more focussing of the condenser and adjusting of the mirror or rectangular prism, or by altering the position of the flame slightly, the best result is soon obtained. I invariably use the edge of the flame for throwing light on the mirror or on the rectangular prism, and often I remove the latter altogether, and place the flame in the axis of the field lens of the reflex illuminator. A white field is best obtained in this way. Sometimes I place the microscope horizontally on a pedestal from 4 to 6 inches high above the level of the table, and I find this a very convenient position for observing. By interpolating a bulls-eye condenser, convex side towards the flame, and by using the broad side of the wick, the prismatic colors disappear and the field becomes white. By turning the microscope a little to the right or to the left on its vertical axis, the best illumination is often very easily secured. The light from the reflex illuminator should fall under an angle of about 6° against the midrib of *Amphipleura pellucida.*

The reflex illuminator may also be used for the resolution of lined tests by transmitted light, especially sunlight, when the objects are mounted *dry and on the cover.* In this way the lines on *Amphipleura pellucida* can be shown beautifully. I have also found that by transmitted sunlight the reflex illuminator may be used for the resolution of either balsamed or dry lined tests mounted on cover, without the use of any liquid medium whatever between the top of said apparatus and the under side of the slide. The value of this method is not confined to lined diatomaceous tests, but may become of great service for biological and other researches.

The immersion objectives, with which I have succeeded in resolving the finest specimen of *Amphipleura pellucida* in balsam, were those of Powell & Lealand on the new formula, the one-quarter inch included, Tolles, and a series of Zeiss from the one-eighth to the one-twentieth inch. I find that a power of about 600 diameters is requisite to separate the markings sufficiently, and that with a power of 1,000 diameters they become quite visible to any one, even on the finest specimens, some of which have resisted all efforts on the part of some of the best manipulators to resolve them. I also find a Ross' Kelner C eye-piece very useful for this purpose, as it gives plenty of light.

Mr. Wenham's ingenious reflex illuminator, whether if used for the purpose for which it was originally constructed, viz., for dark ground, or whether if put to what one might call its illegitimate use, viz., for light ground, becomes therefore one of the most powerful means of resolving lined tests mounted in balsam.—*Transactions Royal Microscopical Society.*

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Reproduction of Hydra.

M. KOROTNEFF has arrived at very different conclusions from those of Kleinenberg upon this subject. According to the latter the reproductive cells occur below the ectoderm and form a mass which serves for the production of both ova and spermatozoids. The process described by him is as follows: one of the cells of this mass increases considerably and swallows up the surrounding cells, or, in other words, feeds upon them. The nucleus then becomes transformed into a germinal vesicle, and finally the cell comes to represent the ovum of the *Hydra*, which is thus in its origin a unicellular and ectodermal formation. The granulations of the ovum serve to produce the larger elements described by Kleinenberg under the name of *pseudo cells*. The blastoderm, according to Kleinenberg, is formed immediately after the conclusion of segmentation, and consists of a layer of cells forming the whole envelope of the ovum. It is regarded by him as an embryonic epithelium, taking no part in the ultimate formation of the *Hydra*, but to be rejected at a certain period of development. Hence the adult *Hydra* is destitute of epithelium.

The author, like Kleinenberg, has observed an agglomeration of cells of ectodermic origin, but regards them merely as embryonic cells, serving to reproduce different ectodermic elements. One of these cells increases, and its nucleus is converted into a germinal vesicle; while at the same time the peripheral elements of the mass separate, forming a row of cells with very small refractive granules, and the central cells unite with each other and with the enlarged cell, forming a common plasmodium sprinkled with numerous nuclei. The germinal vesicle is degraded and disappears entirely; the nuclei of the central cells increase a little in volume and degenerate into fatty bodies, and some of them divide. These are probably Kleinenberg's pseudo cells. The peripheral elements of the mass sprinkled with chitinous granules, form the envelope of the ovum. M. Korotneff concludes that Kleinenberg mistook these peripheral elements for a blastoderm, and the mass of central cells for the result of a true segmentation.—*Comptes Rendus, Sept.* 9, 1878.

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—M. Yung has communicated to the Academy of Sciences the results of his experiments on the action of different colored light upon the development of animal ova and larvæ. Their action, beginning with the most favorable, may be arranged thus: Violet, blue, red, yellow, white, green. The red and green light appeared positively hurtful. Between yellow and white light there was little difference. Tadpoles kept without food died most quickly in the violet and blue rays. The incidental mortality appeared greater in the colored rays than in white light.

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S. E. CASSINO, Naturalists' Agency, Salem, Mass.
J. G. LANGGUTH, Optician, 48 Madison St., Chicago, Ill.
JAMES W. QUEEN & Co., 924 Chestnut St., Philadelphia.
W. H. WALMSLEY, 921 Chestnut Street, Philadelphia.
FRED. WAGNER, 41 West Fifth Street, Cincinnati, Ohio.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

Universal Sub-Stage for Oblique Light.

VARIOUS attempts have been made to produce extremely thin stages, so that light of extreme obliquity might be applied to such objects as the *Amphipleura pellucida*, etc. The most effectual method of securing this result is that suggested long ago by Spencer. This consists in placing the object on the *under* side of the stage. Unfortunately, many microscopes, such as those of Beck, Crouch and others do not admit of this, and in such cases a very simple contrivance, consisting of a short tube fitting into the hole in the stage, and having on its under side a thin plate of metal furnished with spring clips, will be found to answer every purpose. This contrivance, which we have used for a long time with satisfaction, gives not only facility for obtaining extreme obliquity of illumination, but it forms no bad substitute for a rotating stage, and by means of it any special diatom or any tissue may easily be placed so that light shall fall on it in any direction that may be required.

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Correction.

SEVERAL annoying typographical mistakes crept into our reprint of Mr. Charles Stodder's paper on Santa Monica Diatoms, read before the San Francisco Microscopical Society. We corrected several obvious mistakes in the copy sent us, but the following escaped our notice at the time:

For *Cephyria* read *Gephyria*.

For *nacemosus* read *racemosus*.

For *Asterolampra* (page 14, 2d col., line 8 from top) read *Asteromphalus*.

For "R. C. Green," read "R. C. Greenleaf."

The *T. Tumidium* Mr. Stodder has since ascertained is the *T. Trisulcum* of Bailey. Greville's form is only a slight variation from Bailey's.

◆

— Some microscopists who have tried it, claim that castor oil makes a most efficient immersion liquid for some high angle lenses. Kerosene also has been tried with success.

QUINATE OF QUININE.—We are in receipt of a slide of this new object, through the courtesy of Mr. Walmsley, the agent of Messrs. R. & J. Beck. Under a moderate power it forms a most beautiful object, the circular crystals being fringed with rays which, under the action of polarized light are exceedingly brilliant and pretty. If our readers will imagine a circular crystal of salicylic acid, surrounded with a gorgeously colored fringe, they will have a rude idea of this new object.

◆

Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Oleomargarine Again.

Ed. Am. Jour. Microscopy—The article giving "The Microscopical Examinations of Oleomargarine," by Professor Michels, which appeared in a recent issue of this journal, was perused by me with much interest, and I at once resolved to repeat the experiments as detailed.

The first thing requisite was to secure authentic specimens of oleomargarine. In order to do this, I solicited the friendly aid of a prominent gentleman of this city, who is also well known in business circles in New York. I also wrote, independently, to a gentleman in your city, urging him to obtain for me the sample required.

Desiring also to procure a specimen of genuine dairy butter, I applied to a well-known citizen of this city, who procures his supplies directly from a farmer.

After an interval of ten days, I was, in response to my solicitations, in possession of three samples of oleomargarine, and one sample of pure dairy butter. The three samples of oleomargarine are directly from the manufacturers at New York city, and will be referred to as Nos. 1, 2 and 3.

The *four* samples were subjected to examination under the microscope; the objectives used were a 1-4th inch of 100° by Tolles, and Spencer's late duplex 1-4th of 180°.

Samples Nos. 1, 2 and 3, and also the specimen of pure dairy butter, showed many crystals of chloride of sodium; the crystal furnished by the pure butter were, however, cleaner, and more acceptable generally than those exhibited by Nos. 1, 2 and 3.

Samples Nos. 1, 2 and 3, in addition to crystals of chloride of sodium, displayed other crystals, those of nitrate of soda being prominent; while forms closely resembling crystals of *cholesterine* were found in considerable numbers.

Regarding Nos. 1, 2 and 3, it may be remarked that Nos. 1 and 2 were, to outward appearance, tolerably fair imitations of genuine butter, and might by the ordinary purchaser be accepted and bought as such. No. 3 was a poorer counterfeit, and would probably be rejected by most buyers; but if mixed in equal parts with the genuine article, the mixture would be likely to deceive the purchaser.

In samples Nos. 1 and 2 the microscope displayed the "feathery crystals" (margarine) described by Prof. Michels, although these were not constantly present in every field examined. By moving the slide, other fields were brought to view in which these crystals were much more prominent than those given in the cut accompanying Prof. Michels' paper. The crystals of nitrate of soda and cholesterine (?) were to be seen in every slide prepared from the samples named.

Besides the crystals named, samples Nos. 1 and 2 gave "suspicious cells" in large numbers, accompanied by shreds and tissue fibres, many in a broken down condition, while others seemed to be in a tolerably normal state, sufficient almost to establish the presence of voluntary muscle. Bundles of these fibres were closely examined with the duplex 1-4th, under powers as high as 1,600 diameters, with the endeavor to bring out the transverse markings; this was not accomplished—owing, doubtless, to the nature of the *vehicle* (my observations in this direction will be continued). Many of the bundles seen were completely broken down, and the elementary fibres detached.

Sample No. 3, when examined under the microscope, displayed fewer of the "feathery crystals;" nevertheless, this was the most "suspicious" specimen of the three; there were multitudes of "suspicious cells," shreds and patches of tissue, in a more or less broken down state. In one field I felt tolerably sure of finding encysted hydatids. This slide unfortunately, was accidentally destroyed by the water getting under the cover.

To give an intelligent description of this material (No. 3) would require far more time to its study than I have at my command at present; but I hope to attack it again, and at an early day. Suffice it now to say that this specimen contains *very many* "suspicious" elements, and that its behavior under the objective (here I also include Nos. 1 and 2), is—with the exception of the crystals of chloride of sodium, and the presence of a few fatty globules—totally different from that of pure dairy butter.

The sample of pure dairy butter gave fields just as represented by Prof. Michels, with the exception that crystals of the chloride were almost constantly present.

Having established, to my own satisfaction, at least, the integrity of the observations of Prof. Michels, I therefore hold that the gentleman should be regarded in the light of a public benefactor; the matter he has presented will be found worth serious and careful investigation.

In one of my recent lectures before the medical class of this College, on the *Entozoa*, I quoted (substantially) from Dr. Roberts, as follows:

"A marvelous light has been thrown in recent years on the zoological position of the Entozoa, chiefly by the researches of *Siebold* and *Van Beneden*. It has been ascertained that the hydatid worm found in man, constitutes the *encysted* phase in the development of a very minute tape-worm which infests the dog. The tape-worm in question is the *Tœnia echinococcus;* the entire adult animal is so small that it scarcely exceeds the size of a millet seed. It consists of but three segments, of which three, the last only is fruitful. When this segment arrives at maturity, it is cast off, and a new one developed in its place. Myriads of these worms are sometimes found in the intestine of the dog, and their eggs are discharged in countless numbers with the excrements, the eggs so discharged are scattered far and wide; and some of them find their way with the food into the stomachs of men and other creatures suitable for their development. Arrived there, the embryo is liberated; and after penetrating the mucus membrane, it burrows its way, or is carried by the blood current to some distant organ, where it is arrested. Having thus lodged itself, it presently re-appears as a hydatid vesicle, in which are developed the echinococci, as before explained. Dogs in their turn become infested with the corresponding tœnia by feeding on the offal of slaughtered sheep, pigs, etc., which had been infested with hydatids. The echinococci therein contained develop in their intestines into the tœnia echinococci, and thus the circle of transformation and development recommences."

By similar cycles of transformation and development, do we arrive at a class of parasites known in medicine as the ectozoa. This term may be said to include, or be applied to, worms or larvæ of insects that have been introduced into the intestinal canal by accident. Animalcules, such as the hair worm, grub of the fly, may be mentioned; also the larva of the bee, the spider, etc. Among animals, the disease known popularly as the botts, to which the horse is frequently a victim, is caused by such animals swallowing the ova of the *oestrus* or gad-fly.

That oleomargarine manufactured from refuse animal fats, in the manner described by Prof. Michels, and at a temperature not above 120° F., may be a highway through which "eggs so discharged" find their way into the stomachs of men, is too palpably evident to need further comment.

J. Edwards Smith.

Homœopathic Hospital College, Cleveland, O.,
November, 1878.

A Circular Clip for use in Resolutions on some Cheap Stands.

Ed. Am. Jour. Microscopy—My Zentmayer Histological stand (one of the latest) has two sets of holes for the stage clips. Within the back set a clear circle about two inches in diameter may be described from the centre of the aperture of the stage. This allows the complete revolution upon the stage of a slide upon an axial point anywhere selected under an inch cover-glass. In order to utilize this range of positions, I have simply made a single circular wire clip, two inches in diameter, securing the circle by twisting together the ends of the wire, which are finally spread and bent down to form the pins for the holes. That the twisted portion should be raised somewhat from the plane of the circle, and the points bent slightly *forwards* and downwards, are matters which suggest themselves in the fitting of the contrivance, whose circle is concentric, of course, with the aperture in the stage, and whose degree of pressure is adjustable, as is the case with ordinary clips. It is still further necessary, in order to secure a smooth motion of the slide, to protect its edges from the wire, into which it is liable to cut. This may be done in a variety of ways, such as may occur to any one. It has been found sufficient to cut from thin metal a cap or cover a little larger than the slide, perforate its centre with an inch hole, and turn down its edges. This can be at once laid upon a slide, and the two together placed under the clip. Of course, the rotation must be done with the fingers, guided by the eye at the tube, but it is thus possible to place a diatom, for example, at any angle with the oblique light, and with no loss of obliquity, as the stage remains the same, and the slide still rests upon it. C. W. S.

February 20, 1879.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

Rochester (N. Y.) Microscopical Society.—The Rochester Microscopical Society assembled Feb. 10, at the Free Academy, a goodly number of members being present. The minutes of the Secretary were read and approved, after which the society listened to an interesting and able address by James H. Fisher.

At the close of his address Mr. Fisher detailed his experience in the mounting of objects for the microscope. He especially discussed liquid mounts. He had paid much attention to infusoria. He said those who lacked time might be benefited by his experience. One peculiar cement answers every purpose for liquid mounting. The formula for this is as follows:

DR. HUNT'S CEMENT.—Gum dammar dissolved in benzole, to which add enough pure oxide of zinc, carefully and thoroughly triturated in a mortar whilst moistened by a little benzole, to thicken the mixture, so that it will drop freely from a brush. This formula is not in the books.

The cell can be made of any required depth. The cells can be made and put away for use when required. Additional layers can be added after drying, if greater depth is necessary. In mounting the object is placed in the cell, and the cell filled with glycerine, when glycerine is used as the medium. If much water is put in the cell with the object, it should be allowed to evaporate before the cover glass is put in place. It should be put under a bell to keep from the dust during evaporation. When the water is thus removed, and the cell is ready to be covered, the nature of the cement is such that the cement adheres to the cover glass when it is laid on. The glycerine should so completely fill the cell that no air shall remain under the cover glass. If the cement is allowed to become hard, the superabundant glycerine can be washed off by holding the slide under a faucet. The edge of the cover glass is then covered by another layer of the cement. For a transparent cement, an excellent preparation can be made by the following formula:

TRANSPARENT VARNISH.—Canada balsam dissolved in chloroform and turpentine.

This cement can be used with advantage in any case where balsam is employed. This cement was highly recommended.

Mr. Fisher also strongly recommended the following, viz.:

BROOKE'S CEMENT.—To common Brunswick black, add a small portion of India rubber dissolved in mineral naphtha. This cement will never crack when dry, and leaves a very smooth and beautiful finish.

DR. EULENSTEIN'S CEMENT.—Mix equal parts of Brunswick black and gold size, and then add a little Canada balsam.

Shellac solution in strong alcohol may be beautifully colored by aniline dyes.

Mr. Fisher exhibited a remarkable and beautiful species of infusoria obtained from a pond in the vicinity. This species is exceedingly rare, as the pond where it flourished is filled up. The pond was inhabited by goldfish, although it was quite stagnant. These infusoria resemble a pocket flask in shape, the delicate shell being perfectly transparent. The shell is covered with short cilia. From the body in the shell, proceeds, through the mouth of the flask, a long, slender filament, which is the chief organ of motion. The motions of these organisms in life are very rapid and vigorous, as though they were seeking prey.

Mr. Fisher exhibited several recently invented accessories of the microscope, notably the new achromatic condenser, made by Swift, of London. This is an exquisite piece of mechanism. The construction of the microscope was explained. The use of the camera lucida was recommended for drawing objects under the microscope.

Mr. Merriman then spoke in favor of the cement described by him at the last meeting. He had used Dean's gelatine in liquid mountings.

President Lattimore spoke of the extreme simplicity of the methods discussed by Mr. Fisher, and remarked that the simplest was in a majority of cases the best. President Lattimore said that it might be of interest to amateurs to know that the *Volvox globator* was found during the spring at Irondequoit Bay.

Mr. Rebasz stated that they were very abundant in the feeder near Mount Hope.

Ernst Gundlach was appointed to read a paper at the next meeting, and William Streeter, Rev. Myron Adams, and J. E. Line were appointed to furnish microscopes and accessories. The next meeting will be held on the second Monday in March.

After adjournment, the members examined a large number of interesting objects. Among them was a water beetle yet unnamed, which was shown by Mr. Fisher. E. H. Vredenburgh exhibited interesting and beautiful diatoms, and hairs of a caterpillar.

Wellesley College Microscopical Soiety.—The Wellesley College Microscopical Society, composed of teachers and students, has been in successful operation for two years. We have found it such an aid to microscopical work in our institution, affording an exchange where the results of investigation in the different departments could be brought out, and also an incentive to individual research, that we beg leave to send reports of our meetings.

At our first meeting there were present six members, and we had at command but three microscopes. There are now about twenty-five active members of the society, and we have for special work ten microscopes—Zentmayer's American Centennial, and Army Hospital, besides stands from Beck, Tolles, Zeiss and others. We can also command for exhibitions twenty other student stands, Crouch and Beck, from the botanical and biological laboratories. We have an excellent working library, including complete sets of the English Quarterly and Monthly Microscopical Journals, a good line of objectives and accessory and mounting apparatus, and some hundred slides have been prepared for the society's collection by the members. The meetings have been of continually increasing interest, and papers have been presented covering a wide range of subjects.

The regular monthly meeting of the society was held in the Physical Lecture Room, Feb. 8, Miss Fairbank, the President, in the chair. Besides the members of the society, some fifty visitors were present.

A paper was presented by Miss Metcalf on "The Application of the Microscope to the Study of Rocks." This was our second paper on the subject, the first dwelling upon the uses of polarized light. Free use was made of the blackboard in illustration, and after the paper some thirty specimens, loaned by Mr. A. L. Dickermann, of Boston, were exhibited upon the screen, by means of the oxhydrogen light and polarizing attachment.

The first of a series of papers on "Spectrum Analysis, as applied to the Microscope," was next given by Miss Whiting, and illustrated by lantern projections.

The company then adjourned to the adjoining laboratory, where there were exhibited, under some fifteen microscopes, with various powers, specimens of thin rock sections, including: Granite, showing liquid inclusion with moving bubble; dolerite, showing good augite crystal; pitchstone, showing fluctuation structure; hornblende, breaking up into microlites; quartz containing needle-shaped microlites; twin layers of Labradorite; biotite, showing dichroism, etc. Under the micro-spectroscope were exhibited some specimens of crystals.

Miss Nunn exhibited some living sea anemones, which would be ready for microscopical dissection the ensuing week.

The current numbers of the "American Quarterly Microscopical Journal," AMERICAN JOURNAL OF MICROSCOPY, "Quarterly Journal of Microscopical Science," "Journal of the Quekett Club," "Archiv fur Mikroskopische Anatomie," and "Journal de Micrographie," were on the table.

The meeting then adjourned.

MARION METCALF, Corresponding Sec'y.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, January 2, President Hyde in the chair.

Wm. H. Archer, of Melbourne, Australia, was elected corresponding member.

President Hyde reported on four slides of diatoms from Lake Tahoe, received from President LeConte, of the University of California, stating that although the supply of material on the slides was extremely meagre, yet he had found some beautiful and rare forms, and hoped the locality would be more extensively prospected.

The subject of adopting a proposed unit in Micrometric Measurement, in accordance with the suggestions of the late Microscopical Congress at Indianapolis, was brought up for discussion, and a letter from R. H. Ward and A. W. Bower, the Committee of the Troy Scientific Association, giving their views on the matter, and submitting certain propositions, was read and discussed. On motion, it was resolved that a vote of the Society be taken on the first proposition, namely: "Is it expedient at present to adopt a standard for micrometry?" and on such vote, it was resolved in the affirmative.

It was then, on motion, resolved that the metric system should be employed for that purpose.

As to the other propositions contained in the letter referred to, the matter was, on motion, duly seconded, referred to a committee of three to be appointed by the Chair, the committee to report at the next meeting of the society.

The Chair appointed on such committee, Dr. Dennis, Professor Ashburner and Mr. Morris. On motion, the President was added to the Committee.

Dr. Gustav Eisen, who has for some time past investigated the class of molluscs called Pteropoda, exhibited some admirably executed drawings of two species most generally met with near the shores of southern California. The drawings showed the animals in natural size and colors, and also several anatomical details of their nervous, generative and gastric systems.

The class of Pteropoda had hitherto been divided in two orders, viz., Thecosomata and Gymnosomata, the animals belonging to the former being covered by a hard shell, those of the latter bring perfectly naked. The Doctor thought a better characteristic would be the presence or absence of a silicate radula in the palate. The two genera exhibited were very likely new, but seemingly related to Tiedemannia and Pneumodermon.

The wings of the former genus were drawn more minutely, and especially their interior margin was seen in a highly magnified scale. The Doctor had here found some new organs of sense, consisting of an agglomeration of larger cells situated on a pear-shaped body of minute granulated cells. In the middle of the larger cells was to be seen a small opaque pearl-shaped body, immediately connected with a nerve ganglion. Such peculiar organs were distributed over only a small surface of the hyaline wing. The masticatory organs of this genus were situated in the stomach, and consisted chiefly of four pyramidal chitinous teeth. The same organ of Pneumodermon was seen to consist of a radula full of silicate teeth. On both sides of this radula, and also in front of the same, were large round, or triangular bodies, covered with chitinous teeth, between which the food was apparently ground before entering between the teeth of the more delicate radula.

The animals of both genera being hermaphrodites, their male and female generative organs were found to be connected in the same individual. In both genera they seemed to resemble each other to some extent, but, as could be seen by the drawings, those of Pneumodermon were the most complicated, as having near to the exterior porus an additional large prostrate gland.

The Doctor expressed as his intention, in the future, to follow up the study of the whole class, at least as far as the Pacific coast was concerned.

The regular meeting of the San Francisco Microscopical Society was held Thursday evening, Jan. 16, 1879, President Hyde in the Chair.

The report of the Committee on Microscopical Measurement, by President Hyde, first occupied the attention of the society. The action of the committee was as follows: That a standard of micrometry should be adopted; and that it should be based on the metric system; and that the millimetre should be adopted as the unit of measurement.

As to the preparation and preservation of a suitable standard micrometer, the question was considered too technical for the action of the committee.

Finally, with regard to the National Committee, it was concluded best to adopt the proposition that "Each society, eligible to representation at the late National Microscopical Congress, may appoint one member of the committee, which shall be considered formed when at least five members are appointed; the societies to have power to fill vacancies, and the committee to have power, unanimously to add to their own numbers."

Mr. Chas. W. Banks, Corresponding Secretary, presented the Society with three remarkably fine volumes, containing 350 colored plates, "Phycologia Britannica, or History of British Sea Weeds," by Wm. H. Harvey, M. D., London, 1819, the volumes being accompanied by a book of over 50 mounted type specimens of Algæ. A vote of thanks was tendered Mr. Banks for his valuable donation.

President Hyde read a long letter from Dr. R. U. Piper, of Chicago, to himself, in which Dr. Piper drew attention, with abundant detail illustration, to the value in medical jurisprudence of even that negative testimony which microscopy can give in cases of blood determination.

It certainly seems that the harmony of the results reached by independent workers with different methods in this field, indicates an exact and certain basis, upon which the courts can rely.

Dr. Piper, wishing to make his communication practical, gave the details of many interesting cases, and after the reading of his letter, the members maintained, until adjournment, a discussion upon this perpetually interesting subject.

State Microscopical Society of Illinois.—A regular meeting of this society was held at the rooms of the Academy of Sciences, 263 Wabash Avenue, Chicago, on Friday evening. Dec. 13, Vice-President, Atwood in the chair.

A number of stands were on the table. The objects were mostly confined to diatomaceous material from the Lake. Messrs. Thomas, Summers and Atwood exhibited gatherings from the Crib, at various depths, obtained from dredgings made at the instance and with the assistance of the City Engineer, Mr. Cheeseborough, in the desire to throw light on certain newspaper charges that the water supply was polluted by the river and sewage discharge.

A formal report of the committee appointed to investigate the subject microscopically will, no doubt, be an interesting document.

During the discussion of this subject, Mr. Palmer, a visitor from the Boston Microscopical Society, expressed surprise at the presence, at this late season, of the rotifer Noteus quadricornis in the water from our hydrants.

Dr. Vielie exhibited a puff ball, species not determined, measuring 22¼ inches in diameter.

Several names were proposed for membership, and a number of prominent microscopists proposed by the Board of Trustees to the society were duly elected corresponding members.

The Secectary then read a short paper on the microscopical structure of the seed of Physostigma venosum, prefaced with an account of its origin and uses. The paper was illustrated by slides and microphotographs.

The regular meeting of the State Microscopical Society of Illinois was held at the Academy of Sciences, Chicago, Jan. 24, President Fuller in the chair.

After the election of members, and the transaction of some routine business, the Secretary read a communication from a committee of the Microscopical Section of the Troy Scientific Association, in regard to the adoption of a unit of micrometric measures, with reference to action of the American Microscopical Society at its next meeting.

After an expression of views by various members, the matter was referred to a committee consisting of Profs. H. A. Johnson, M. D., Lester Curtis, M. D., H. H. Babcock, and Mr. H. W. Fuller, to consider the subject and report recommendation for action at next meeting. The committee was requested to invite suggestions, not only from microscopists, but from scientific men whom they considered competent to advise on the advantages of the metric system.

A paper entitled "Have the Mammalian Blood Corpuscles a Nucleus?" was then read by Professor Belfield, of Rush Medical College. After reviewing the recent literature of the subject, the gentleman gave an account of his own experiments, abstracted as follows: Specimens of blood were procured from man, the dog, rat, rabbit and turtle. These were subjected to various bleaching agents—chlorine, sulphurous acid, acetic acid, and a freezing temperature. They were then stained with carmine and aniline. By every method there were demonstrated sharply defined bodies within the turtle's blood corpuscles which showed a heavy staining, the rest of the corpuscle remaining colorless; but in no specimens of mammalian blood was there any differentiation of color. Some of them (the mammalian corpuscles) showed uniform staining from centre to periphery. This would seem to prove, as far as staining can prove anything, the absence of a nucleus from the mammalian blood corpuscle.

The Doctor referred, in closing, to the so-called claims of the late Dr. Freer, of this city, of the discovery of a nucleus in the human blood corpuscle by the use of the method suggested by Dr. Johnson, of viewing objects with high powers by reflected light—stating that Dr. Freer suggested that the peculiar appearance of the corpuscle when thus examined might be due to the presence of a nucleus. This suggestion, however, was not endorsed by eminent medical gentlemen in England and Germany, to whose attention he brought the subject while abroad, and on his return he had quite abandoned that theory.

Dr. Belfield's conclusions were confirmed by a number of competent medical gentlemen present.

Adjourned.

ERNEST B. STUART, Secretary.

Academy of Natural Sciences, of Philadelphia.—The Biological and Microscopical Section met Dec. 16, 1878, Dr. R. S. Kenderdine in the chair.

Prof. J. Gibbons Hunt delivered a very interesting lecture on the lichens. His remarks were beautifully illustrated by many fine specimens of his own preparation, demonstrating the minute structure of these simple plants, which are found everywhere encrusting rocks, stones, the bark of trees, etc. A dish in which a large number of specimens were tastefully arranged by Prof. Hunt under a bell-glass, attracted much attention, forming as it did a display quite equal in beauty to the handsomest fernery. Speaking of their habitat, the speaker said that these, as well as many other interesting plants, were found in the greatest profusion and variety in the swamps of New Jersey, which he called the paradise of the botanist. After going briefly over the classification of these plants, the lecturer entered upon their anatomy. The great interest and value of the study of these plants as a means of mental discipline, and their use in the arts of design, were also dwelt upon by the speaker.

Mr. Lewis exhibited a specimen of a rare wheel animalcule of marvelous beauty belonging to the genus *Stephanoceras* from the vicinity of Philadelphia.

The Biological and Microscopical Section of the Academy of Natural Sciences of Philadelphia, met Jan. 6, Dr. R. S. Kenderdine in the chair.

Dr. Carl Seiler favored the society with a discussion of the leading facts of animal histology, the branch of science which has for its subject-matter the consideration of the various kinds of cells composing animal bodies. He considered the classification of the living tissues according to their offices. These, he said, could be very simply and conveniently divided into three classes, as follows: 1st, connective; 2d, epithelial; and 3d, the nervous. The speaker's remarks were illustrated by numerous beautiful microscopical objects prepared by himself, some of which showed as many as four different colors, each component part of the cells being of a different color, all of which had been accomplished by artificial means, though the process was comparatively a simple one. The great practical use of the study of histology, and the comparative ease with which its main principles might be acquired, were dwelt upon, as well as the great facilities which were now offered to students, owing to the mechanical and optical perfection of American microscopes, and the excellence of the technical processes devised and discovered by our own students.

Some further remarks were made by Dr. Dixon, Mrs. Prof. White and Dr. Hunt, the latter of whom differed with Dr. Seiler in relation to some minor points relating to the origin of the connective tissues.

Mr. J. A. Ryder then offered a resume of recent researches on the very first stages of cell-division and multiplication as worked out by the younger European biologists, who seem to have left off where the older workers began. These researches, he believed, indicated more decidedly than ever the identity of animal and vegetable protoplasm. In both the animal and vegetable cell the behavior of the central nucleus of the cell seemed to be quite the same; as it elongated preparatory to division, it was seen to be composed of two opposite poles, from which very minute granules were disposed in lines radiating in every direction, whilst curved lines of granules connected the poles. The appearance was that presented by iron filings scattered on a plate of glass, and made to arrange themselves in a curious fashion when the poles of a horseshoe magnet are applied beneath. It was not claimed that the process of cell division was a magnetic process, but it was simply a resemblance which was suggested between the two phenomena. The curved lines of granules uniting the poles of the cell-nucleus, in the course of time, form nodes or enlargements which mark the point of division equatorially of the cell into two. The radiate arrangement of the granules at the opposite poles of the nucleus has induced Fol to call it an "amphiaster," meaning like two stars joined together. The formation of the female and male pronucleus in the egg-cell was also considered, and shown to be produced previous to fertilization, at least in the case of a star-fish and a small species of leech. Many further observations were offered in regard to certain recently-discovered phases of embryonic development.

Mr. Lewis exhibited a fine living specimen of wheel-animalcule, the Lymnias.—*Am. Naturalist.*

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

I have for exchange a Kinne self-centering turntable with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypens, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod, and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¾ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 243, Greenport, Suffolk County, N. Y.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

Three Wenham compressoriums for a Cox's self-centering turn-table complete. Geo. A. Mitchell, Hanover, N. H.

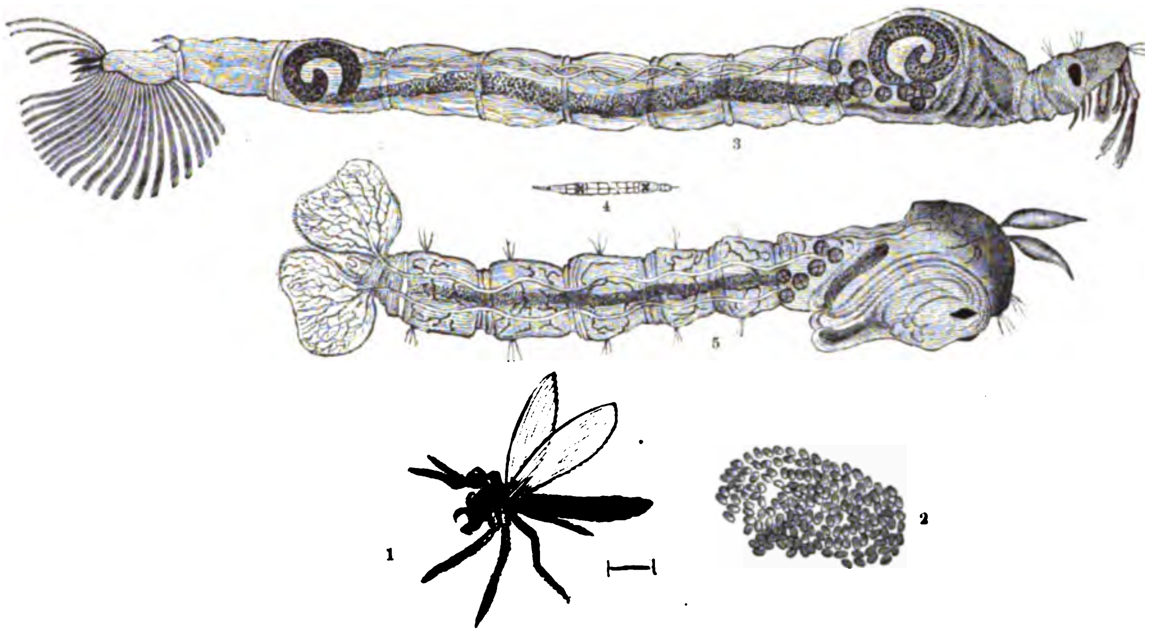
Slides of moss persitome Funaria hygrometrica, for any good object or material; also slides of named diatoms for other named varieties. Jos. McKay, 24 Liberty street, Troy, N. Y.

Marine algæ, diatoms in situ on algæ, musci, hepoticæ, ferns, lichens, lycopodiaceæ, etc., in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Living specimens of Volvox globator sent for a mounted slide. E. W. Holway, Decorah, Iowa.

Wanted for a choice collection of mound builder's and Indian relics, a good binocular stand. Address Rev. J. D. King, Chatham, Mass.

Wanted, a good microscope stand, binocular preferred, in exchange for photographic lenses. N. Taylor, 676 Broadway, New York.



CORETHRA PLUMICORNIS (?)

1. Imago. 2. Eggs. 3. Larva, magnified. 4. Larva, actual size. 5. Pupa, magnified.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. IV. NEW YORK, MARCH, 1879. No. 3.

Corethra Plumicornis.

BY HENRY MILLS.

AMONG the many interesting microscopic objects found in the vicinity of Buffalo, is one well known to microscopists of the first class in England, but a stranger in this country, so far as we know, till very recently discovered in the ponds in this locality by members of the Buffalo Microscopical Club.

We have reference to the skeleton larva of *Corethra Plumicornis*, a dipterous insect placed by some under the family *Tipulidæ*, but probably more correctly belonging to *Culicidæ*.

This is a small animal about five-eighths of an inch in length, and one-sixteenth of an inch in width, so transparent that it would probably escape notice altogether, were it not for its black eyes and two dark spots on its back. An extraordinary jerking motion when seizing its prey, or moving from place to place, might also attract attention. Without illustrations it would be impossible to give any adequate idea of this interesting object; and to be fully appreciated, the creature itself must be seen for a long time, and in many positions. We can refer, however, to the *Popular Science Review* for 1865, in which is a valuable paper by Ray Lankester, with drawings. Also to the "Transactions of the Microscopical Society for 1867," where there is an article by Rymer Jones, with very beautifully executed illustrations. Both the above articles are good, but not exhaustive. This creature has six pairs of oral appendages, and one pair of auxiliary spikes beneath the mouth. The first pair are long hooks forming a sort of beak, and giving the animal a remarkable appearance even with a pocket magnifier. Behind these are five other pairs or sets—one or two plumose—for various offices connected with the seizing, holding and eating of its prey. Some of these hooks are of wondrous shape and beauty; and all together they go to make up a most interesting mouth.

The eyes are large and compound in character. In close proximity to the large one, is a simple rudimentary eye, which Lankester thinks is a mere mass of pigment, and not provided with a lens. According to the same writer, the animal has eleven segments. The dark spots on the back, referred to above, are two pairs of respiratory organs. The first pair is near the head, and the second pair is on the third segment from the tail. These respiratory organs are made up of spiral threads, precisely after the manner of the silk-worm and other insecta; and when the larva passes into the pupa state, these become compressed and elongated, and fall into their proper place, forming the principal tracheal tubes. Near the first pair of these organs may be seen the gizzard, and the slender canal leading to the alimentary canal. The large intestine comes after the second pair of respiratory organs. With a good objective, and careful manipulation, may be seen the whole alimentary canal and chain of nervous ganglia, as well as the action of the simple dorsal vessel or heart, as it draws and returns the nutritive fluid. The plumes on the posterior part of the body are, one terminal, and one lateral. The terminal plume consists of four feather-like hairs, and the lateral twenty-two. The last named is fan-shaped, and is not only ornamental in the highest degree, but undoubtedly serves as a rudder, as it seems to be just what would be needed to enable the animal to make its rapid jerking movements. There are also four terminal plates which are connected with the tracheal system.

We urge all microscopists to be on the lookout for this beauty, assuring them that, if successful, they will be well paid for their trouble. The larvæ are eminently interesting, showing at a glance, and without difficulty, except that of ordinary skilful manipulation, the whole internal structure of a very fine specimen of animal life.

Buffalo, N. Y.

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The Siliceous Shelled Bacillariæ or Diatomaceæ.

Continued from page 167, *Vol. II.*

GENERALLY these organic substances form in the beginning a cohering skin, which subsequently splits in length and also in breadth, so that in many cases it is divided into four plates, which later separate themselves into smaller parts; and occupy then the interior of the frustule in the form of small pellets, which in the *Melosireæ*, *Fragilarieæ*, and other forms, are exactly similar to the cell contents of the confervеæ. I shall also here, as with the algæ, call these contents *gonimic substance* (substantia gonimica). Ehrenberg calls them ovaries, because he considers the diatoms organized animals, but it is remarkable that such an ovary in its development presents revelations which only find their analogy in decided plant forms, and not the least thing has been observed as yet which could justify Ehrenberg's assertion. The gonimic substance is indeed colored brownish yellow, but it becomes in many dried diatomaceæ green, after the drying, (especially in the fresh water *Melosireæ*). Chlorohydric acid also changes the brown color to a beautiful green, and alcohol draws out of the fresh living, and likewise out of dried specimens, a green colored stuff which comports itself like *Chlorophyll.*

In addition to this gonimic substance, one also finds, in almost all forms, bright colorless balls, which look like little bubbles or globules; sometimes their number is small, often only two are apparent, again there are cases where they are numerously developed, and it appears to me that the condition of the weather has an effect upon them; thus, one finds e. g. *Navicula gracilis*, in the early spring days with us, with only a few of these pellets, but the same species, after continued warm weather, shows the so-called bright bubbles in great number; I have observed the same thing in *Gomphonema dichotomum*, and *Diatoma mesodon.* There appears to be here a case parallel to the starch structure in the *Closterieæ*, *Euastreæ* and *Conferveæ;* these little balls are shown in our plates Tab. 3, xxxiii, xxxiv, xxxvii, 1; Tab. 6, iv*a*, iii, viii, ix, xiii; Tab. 16, iii, 3, 4, 5, 9; Tab. 30, fig. 39, 48, 57, 78. Ehrenberg has called them seed vesicles, but strict and close observation has convinced me that these supposed seed vesicles are mere oil-drops, and have not the slightest envelope; that they were oil-drops I perceived in 1835, when I examined in Trieste, the *Micromega myxacanthum*

(Tab. 24, viii, 4, 5). I noticed that by slight pressure between two glass plates, the drops extended, then united and flowed out, so that they were frequently to be seen in the mucous envelope outside the Navicula (Tab. 24, viii, fig. 5*). One can easily see the separation of these drops in all the *Naviculeæ*, if one observes them during the drying under the microscope; just as the moisture of the frustule, which envelopes the oil drops, and maintains their form, disappears, they will spread themselves on the frustule and vanish. Here the oil seems to take the place of the starch in the cotyledons of the cruciferеæ.

Finally, there are still other forms which Ehrenberg calls "stomach sacs" (Magenblasen). I have noticed them especially in a few *Naviculeæ* where, particularly, they lie around the middle opening of the valve (Nebenseiten). They appear to be small, well defined rounded bodies, mostly white, which in *Navicula gracilis* (Tab. 3, xlviii, first and fourth figures), *Stauroneis platystoma*, (Tab. 3, xlviii, a, b), arrange themselves in a circle around the middle opening. In *Navicula major* (Tab. 4, xx, a) they are also present, but irregularly disposed. In *Navicula cuspidata* (Tab. 3, xxxvii) they form two somewhat crooked longitudinal rows. Ehrenberg has ("Die Infusorien," etc., p. 242) seen these bodies become blue, when he placed various diatoms in water mixed with indigo, and he thence concludes that the middle opening of the valve is the mouth, and the indigo colored bodies stomach sacs, which had absorbed the colored fluid; but there is something suspicious about this, that the *Naviculeæ* only take up the color when one lets them stand beforehand a few days in indigo water, and then pours off this, and presents new water and new indigo; the absorption does not follow then in all cases like that in the true *Infusoriæ*, but only under certain restrictions; (moreover, I have not hitherto been able to observe this absorption of colored matter, although I have made many attempts, strictly according to Ehrenberg's directions). There is, indeed, an absorption of colored matter possible, without assuming the digestion of the same by the *diatomaceæ*,* and the separation in or upon the little bodies lying nearest to the middle opening, is so much the clearer, because here the nearest inward parts exert a stronger mechanical attraction upon the penetrating fluid than elsewhere; also Ehrenberg says, "In dead animals the inner parts color themselves indiscriminately." If now these bodies were truly stomach cells, they must be present necessarily, and always, in all individuals and in all species, but it is not so. I have, moreover, often observed (and make this assertion at the same time when millions of *Navicula gracilis* and other species are before me, living in a dish), that in many individuals, the supposed stomach cells are totally wanting, which indeed could not be the case if they represented so important an organ as the stomach.

All diatoms secrete out of the opening of their frustules a slimy substance (substantia gelinea) which is not always observed in the *Naviculeæ* if they are not massed together, but mixes itself with the water and disappears. If, however, certain species (e. g. *Navicula Appendiculata*) only live in moist places, then this slimy mucous substance increases, and the *Naviculeæ* are completely enveloped by it. Something similar to this takes place if diatoms in a little water rise to the surface, and keep themselves in a mass, then the secreted slime runs off, but not wholly, into the water, but spreads itself as a tender skin upon the surface of the water, uniting the single, and often very varied individuals. I have found different diatoms quite as frequently enveloped in this slime as without it. Thus one finds, not unfrequently, in the spring, upon stones in gently flowing waters, very soft mucous

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*So far as the absorption of indigo is concerned, there can be no doubt that this does occur along the raphe or median line of many of the diatoms, e. g. *Stauroneis*, and also along the alae of the *Surirelleæ*, but I have never seen it color the balls alluded to. Ehrenberg and Kutzing assume that the central and terminal nodules are openings, an idea long since abandoned, and the very reverse of the truth.—*Trans.*

masses, which contain various species and genera (*Meridion circulare*, *Cymbelleæ*, *Gomphonemeæ*, *Synedreæ*, etc.), which one finds also scattered between conferva and other fresh water algæ. Therefore this formless mucous envelope cannot always be affixed as a specific character, as Ehrenberg has considered it. The movements of the single diatoms depend upon the separation or adherence of the slime; the latter becomes suppressed in all the *Naviculeæ* and their allies. As soon as the separated slime gains consistency, and so becomes the occasion of a social connection with a number of individuals, one then always observes that the congregated individuals unite, and order themselves to each other, according to certain rules, either in longitudinal or diagonal rows, or star or fan-shaped. This arrangement I have observed in most *Naviculeæ* that I have kept in my room living in cups moistened with a little water.

In many other cases this so-called mucous-like substance separates itself remarkably at the ends; many diatoms, e. g. *Synedraseæ*, *Gomphonemeæ*, *Melosireæ*, and allied genera, like to fasten themselves on certain firm objects in the water, and order themselves in a more or less regular manner, and attach themselves by means of the slimy gelatinous substance which they secrete upon the sessile end. This substance is occasionally only a little observable (e. g. in the *Synedreæ*, which belong to the tribe Ulnaria) in many species it is so apparent that it spreads itself out into a distinct foot (stipes) upon which the body sits fast, (e. g. *Synedra fasciculata* and allied forms (Tab. 15, fig. v) this foot lengthens itself in time (Tab. 15, xiii and xiv, and Tab. 16, i), and becomes in the *Gomphonemeæ*, *Rhipidophoreæ*, etc., a long dichotomising branched thread (Tab. 8, xiv) which also, in many cases, is recognizable as a tube (Tab. 18, Fig. ii).

In certain genera, (*Encyonema*, *Schizonema*, *Micromega*, etc.,) the separated slime develops itself into a gelatinous tube (tubulus gelineus) in which the frustules, increased in number by sub-division, order themselves in rows; often many such rows appear beside each other, and in this case every individual now occupied only its own particular tube, the tube grows like the branched stems of *Rhipidophora*, *Licmophora*, and allied genera, and forms itself into branched gelatinous threads, or, in the higher developed forms into stiff, branched little trees, of firm cartilaginous consistence, which has a striking similarity to the bodies (phycoma) of the higher species of algæ (Spaerococcus, Gigartina, Chondria, etc.) (Tab. 28, i–iii).

To be continued.

Annual Address by President Henry C. Hyde to the San Francisco Microscopical Society.

San Francisco, February 13, 1879,

To the Members of the San Francisco Microscopical Society:

Gentlemen—Another year of our organization has elapsed, and at the close of the seventh year of our society's existence, it has become my duty, as well as pleasure, to give you a brief statement of our progress, material and otherwise, and, to some extent, the progress of microscopical science in general.

During the present year our society has had an accession of eleven new members, of whom two were resident and nine corresponding. We have lost one resident member by resignation; none, I am happy to state, by death or default of dues; and we now number 30 resident members and 48 corresponding; 10 life and 5 honorary members.

We have held during the year twenty-five stated meetings; all, indeed, that we could hold, with the exception of the one occurring on the national holiday, and one other occasion when we lacked a quorum.

Our meetings have been fairly attended, the average attendance being 11; and the entire roll of visitors for the year numbering 42.

Our annual reception was held at Mercantile Library Hall, on the 23d of May, 1878, and was largely attended. There were twenty-two exhibitors, using thirty microscopes, with the usual variety of objects and apparatus, and some few novelties which were fully discussed at the time. But one thing I may remark, and that is, the noticeably unabated interest in this class of scientific exhibitions, and the increased number of fine instruments in use. I believe these receptions, of which that of last May was the sixth, have done a great deal toward spreading the desire of cultivated and intelligent persons to possess and understand the uses of an instrument of such exquisite finish and perfection as the modern microscope, and which, in the hands of any intelligent person, is, if nothing more, a piece of mechanism, an optical contrivance, an intellectual toy, capable of gratifying a laudable curiosity into the constitution of everything about us, and of exhibiting the marvellous beauties which nature has jealously placed beyond the reach of our unaided human vision, to an absolutely unlimited extent.

Our library, which numbered 277 volumes at the close of last year, has since that time received some notable and valuable additions.

By purchase, we have acquired nearly 90 volumes from the library of Dr. Arthur Meade Edwards, the very cream of a large and rare collection of scientific literature, and at extremely low prices.

By donation, we have been favored by Dr. Wythe with four fine volumes—two of text, and two atlases of plates of Raspails' "Nouveau Systeme de Physiologie Vegetale" and his "Nouveau Systeme de Chimie Organique;" and by Mr. C. W. Banks with three volumes of Harvey's "Phycollogia Britanica"—perhaps the finest work on British algæ extant—containing upward of 450 beautifully colored plates, besides some twenty-six specimens of algæ, exquisitely mounted on cardboard, so that these natural types may be compared, side by side, with their colored figures and printed description. Many of the specimens have microscopic shells and diatomaceæ still adhering to them.

Dr. Gustav Eisen has presented to the society his published monograph on the anatomy of the Ocnerodrilus (a species of earth worm), remarkable for its fine illustrations of the minute anatomy of these animals, and the perfection of detail exhibited in the drawings.

Mr. W. A. Woodward, in behalf of the Victorian Government of Australia, has presented us with four magnificent folios upon those wonderful plants, the "Orchids of Australia."

Our library now contains not less than 412 volumes—an accession of 135 volumes—of a value known to but few of the members; and the treasures of which, in all their richness, are hardly accessible to any of us—this resulting from lack of space, proper classification, and sufficient cataloguing and indexing. To reform this would be to many of us a labor of love, and I have promised myself, with some assistance, the accomplishment of it at an early day.

The cabinet of the society, which, at the last counting, numbered 859 mounted slides, has received so many additions that I can only mention a few of the most interesting. Among these may certainly be assigned a small but valuable collection of slides mounted by Dr. Carpenter, the father of modern microscopy, with his own handwriting upon them—several appearing to be the indentical originals of illustrations in his well-known and valuable Manual on the Microscope. These were the donation of Rev. Dr. Bleasdale, of Melbourne.

Mr. Attwood, of Saucelito, has supplied us with quite an extensive collection of rock sections and fragments of the rocks from which the sections were cut (twenty-two in number), to illustrate a novel and most effectual method of examining and studying rock structure, of such extreme simplicity as to enable the most unskilled manipulator to conveniently and quickly examine the structure of rocks without making sections, which, with all the necessary tools and appliances, is, at best, a tedious and troublesome business. The method is briefly this: A fragment of rock is rubbed to a flat surface on a piece of coarse sandstone, then on a finer stone, until a plane surface, moderately smooth, is obtained. This is warmed and painted with warmed Canada balsam, then put away to dry. When dry, the microscope gives an admirable view of its structure, seeming to penetrate into its depths in a truly remarkable manner. The highest power practicable with an opaque object may be used, and, with sunlight, as nearly vertical as can be had, the effect is wonderfully interesting. The rocks and sections illustrated a paper of Mr. Attwood's, which will be noticed later.

The society's cabinet has also received some additions in the way of mounted diatomaceæ, which deserve more than a passing notice, from the fact that this class of mountings presents so many types of variation in quality, from utter trash to almost ideal perfection, and the further fact that these have been prepared and mounted from the crude earth, by one of our members, Professor Ashburner, in a manner that has not been excelled by any one up to the present time, and has been equalled by very few. This will not seem extravagant praise to those who are familiar with these beautiful objects, and have examined the slides referred to.

Dr. Warren, of Walden, Mass., has presented us with a set (16 slides) of well-mounted slides from diatomaceæ deposits in his neighborhood.

But the largest addition to the cabinet has still to be noticed.

Upon the breaking up of Dr. Arthur M. Edward's collection of books and materials, in consequence of hopeless ill health, the opportunity was offered the society to become the possessors of his well-known collection of diatomaceæ, in mounted slides, some three thousand in number, together with a large quantity of unmounted material from all parts of the world. The price at first asked was too large for our means, but the figures were finally reduced to $400, and this proved so great a temptation that the trustees resolved, after a full discussion in open meeting, on at least two occasions, to make the purchase if an amount could be raised by subscription among the members so as to reduce the society's contribution to a sum of about $100. This was accomplished through the generous contributions of a few of our opulent members, headed by Mr. Davis, Dr. Whitney and Mr. Lent, subscribing $50 each, and we are now the owners of this collection, a veritable prize to any microscopical society. The crude materials, of which there are 200 or 300 pounds, is "current coin of the realm" among microscopists, and as a medium of exchange will give our society peculiar and lasting advantages. Up to this time we have not arranged and classified this material, for want of space and proper conveniences; difficulties we hope soon to overcome.

Of Smith's diatomaceæ we have received the second and third centuries, and the entire cabinet now numbers 4,127 slides.

As to our financial condition, the report on file of our most excellent and indefatigable treasurer will convey the required information, and I think you will find the affairs of the society in a satisfactory condition.

During the year, besides the discussion of stated topics at our meetings, there have been presented and read a number of instructive, and, we believe, valuable papers, several of which I propose to mention, not only to show what has been done, but to remind the producers of such good work that *more* from the same quarters must and ought to be looked for.

Mr. J. P. Moore has given a description of a strange new fungus from the Sandwich Islands, which he has named Polyporus (merisma) Kalakau. Also, a paper on a curious pest of the furniture and cabinet makers, called the laurel wood borer; and, in connection with that, some remarks on another similar pest affecting the madrona of California.

Dr. Eisen has also given us some interesting details of the anatomy of two species of Pteropoda, found on the coast of Southern California, and he believes he has made some discoveries regarding their sensory organs.

From Mr. Clarke, our Recording Secretary, we have had a paper on the Vibration Microscope, invented by a French physicist, Lissajous, to investigate the extremely rapid motions of sound-producing bodies; an instrument which, though it cannot magnify time—that is, make a vibration lasting one one-thousandth of a second seem to last a second, as the zoologist's microscope makes an animalcule the one-thousandth of an inch long, seem an inch long—yet at least enables the observer to follow the path of a very rapidly moving point, making the differences between sounds of various intensity visible to the eye.

Mr. Clarke has also given us a translation of Professor Haeckle's paper on "The Alternate Generation of the Echinodermata;" also a paper on "The Origin and Formation of the Hard Tissue of Animals."

From Mr. Melville Attwood, a paper on "Porphyry," illustrating the difference between the true rock of this name, and the so-called "porphry," which the Comstock miner is *continually* meeting in his underground explorations, conveniently or otherwise, but to the great detriment of stockholders. Mr. Attwood has devoted a great deal of intelligent labor and study to the rocks and mineral-bearing lodes of this coast, especially of the Comstock vein, and has made a large collection of authenticated types of foreign as well as native specimens. One of the objects of this paper was the elucidation of a theory, resulting from Mr. A.'s long experience as a geologist, and some rather exceptional advantages of observation and study, as to the coincidence of gold-bearing rocks with the presence of walls of green-stone (diabase). While not absolutely demonstrated, the theory is very plausibly presented, and, under his continuing and unremitted observations, may yet reach an approximate demonstration.

Another object of the paper was the explanation of a new process for examining rocks and studying their structure without making sections, which I have described in an earlier portion of this report.

This paper was reprinted in the memoirs of the Geological Society of London.

Dr. Whitney, Sr. besides some extended remarks on the subject of the microscopical examination of sea water, wherein he stated that his experiments justified the theory of the silica in solution being the probable source of sand, as well as the foraminiferous shells and diatomaceous frustules, has given us an elaborate essay on the "Origin of Life," advancing a system of cosmic philosophy, novel in some important respects, and indicating a vast amount of profound and laborious research.

From Dr. Mouser we have had a most interesting and instructive paper on "The Microscope in Medicine." The difficulty of such a subject being to compress it into anything like suitable dimensions, the paper in question gives an account of the progress of the general use of the microscope in medicine during the last thirty years, and conveys to the non-professional reader an excellent idea of its great value as an adjunct to other means of diagnosis in the study of disease. Dr. Mouser's papers, as well as his remarks on any subject before the society, are always accompanied by actual illustration by means of anatomical and pathological specimens of his own mounting, and, it is no praise to say, of great excellence. Dr. Mouser has also given us a description of a very convenient and handsome cabinet for microscopic apparatus and slides, designed by himself and built by a skillful workman of this city.

From Dr. Anderson, our corresponding member at Santa Cruz, we have had a short paper on "The Fruiting of Sea Lettuce," also a collection of named algæ of the Pacific Coast, bound in a volume, and numbering 177 specimens. This is a work of great labor, and a valuable addition to our collection.

Mr. Wickson has contribhted a paper on an odd but very practical subject, viz.: "Artificial or Oleomargarine Cheese," and the mode of distinguishing it infallibly from the genuine article by the microscope; a means not to be despised when it said that large quantities of the artificial cheese are sold in New York, and shipped to Europe—a statement I am quite ready to believe, but am rather skeptical as to another fact stated in the same connection, that chemical analysis has shown the artificial cheese richer than the genuine.

From Mr. Charles Stodder, of Boston, we have a paper on the "Diatomaceous Deposit from Santa Monica," on our coast—the deposit which has attracted so much attention from diatomists both at home and abroad. He mentions the interesting fact that in this deposit he finds species which have never before been found together, but only in widely separated deposits, so wide apart as Spain, Greece, and the Clyde. Besides these there are some new and extremely beautiful species described.

Your president has given you a paper on "The Microscope in Medical Jurisprudence."

A brief statement of a few of the leading improvements and occurrences in connection with our science may not be uninteresting.

The angular aperture war still goes on. The advocates of "plus 180°" on the one side, and the opponents of that especial term on the other. I have always thought the expression misleading and not descriptive, to say the least, though when explained, it has some plausibility. But the subject is too difficult and complicated for me to undertake any exposition of it at this time.

I believe I may, however, say that the war has supplemented the labors of the diatomists in producing improved objectives, and so long as the "battle of the glasses" has the effect of improving the weapons of the opposing forces, for the equal benefit of the combatants, the lattter certainly should not complain.

Among the improvements in object-glasses may be mentioned a curious invention of Mr. Gundlach—a thin film of glycerine between the front lens and a transparent disk of thin glass in front of it. The effect claimed for this is a nearly perfect compensation for thickness of cover glass, an increased working distance—the object remaining in focus during adjustment—besides general facility of manipulation. But I have not yet seen these glasses, nor any one who has used them.

Another improved objective is the "oil-immersion," by Carl Zeiss, of Jena, which has been subjected to a very critical and searching trial by Rev. W. H. Dallinger—certainly a most excellent authority; and he, comparing this lens with one of the "new formula" lenses of Powell & Lealand, probably the finest in Great Britain, testifies that "All his most critical tests were equally mastered by the lens of Zeiss; and, while he could not do *more* with it than with the English glass, he could accomplish the same results much more readily."

This high praise is, however, much qualified by the restrictions which he finds the peculiar construction of the glass imposes upon its general use. The immersion fluid being cedar-wood oil, dispenses entirely with screw-collar correction for thickness of cover, from the fact that by the use of this oil, having a refractive index as nearly as possible coincident with that of the glass of which the covers and the front lens are composed, the covering glass, whether thick or thin, together with the oil and lens, become practically one homogeneous whole. For this reason, therefore, it is necessary that the fluid in which the object is mounted should be of a particular index of refraction, as, for example, that of Canada balsam, or some other fluid of equal refractive index; and it seems that when this condition does not exist, an object is no better shown by this lens than by any other immersion lens.

These new lenses have also been subjected to American criticism at extremely able hands, and after a most careful and conscientious comparison with our own Spencer's glasses, the verdict of Prof. H. L. Smith is in favor of the latter. Perhaps, encouraged by this well-deserved commendation, the Spencers have determined, as they lately informed me, to manufacture these oil immersion lenses; and while it is pretty safe to say that they will be an improvement on their prototype, we can only wonder what they will be. Our own country is still ahead in the production of the finest optical instruments, while the spirit of emulation is rife among opticians of all countries, and the future of discovery and improvement in this direction is as promising as the past is instructive.

Amongst improved illuminating apparatus, that which has lately attracted the most attention is Col. Dr. Woodward's prism, a small right-angle prism, at first somewhat difficult to use, but as its results were gradually found to be independent of its supposed necessary adjuncts, these were successively discarded, until now the most approved form seems to be the prism without any mounting whatever, made to adhere to the under part of the slide under observation through the medium of a drop of glycerine. It is claimed for this little piece of apparatus that it supersedes *all* the previously invented complicated and cumbersome appliances for obtaining an oblique beam of light. I have not yet had an opportunity to examine into the merits of it, but expect to be able to do so very soon, when I shall have pleasure in exhibiting it to you.

The great value of oblique light in most examinations under the microscope lies in the fact that, ordinarily, we do not view an object with the microscope as we do with the unaided eye—that is, looking *at it* or superficially, but looking *through* it, by transmitted light, just as with the naked eye we should hold up any translucent substance between the eye and the light for the purpose of getting a view of its internal structure and the relations of its different parts. Now, in all such attempts, every one must have observed that looking straight through the particular substance, the eye altogether loses the perception of its surface appearance, or if seen at all, it is so mingled with the effects of the internal structure as to render one or both more or less confused—and the natural impulse is to turn the object a little to one side or the other to get the effect of slanting light, which at once enables the eye to distinguish between the different sets of views.

So in the microscopic vision of transparent objects, when the glass has to be brought so extremely close to the object, such object can, in general, only be examined by means of transmitted light through an extremely thin section, or by reason of the transparency of the object itself. If, then, we can obtain light of obliquity enough to light up the object so that it will appear as if self-illuminated, that is, none of the rays passing directly into the eye, we have the nearest approach to the conditions of ordinary vision, and hence a far better comprehension of the nature and structure of the object than can possibly be obtained by direct or axial illumination. It is this want that has lead to so many devices for procuring light, and they have gradually been more and more simplified.

The subject of micrometry has lately received a great deal of attention. It has long been known that there is within certain limits a wide variation in the measurements of different micrometers, there being no definite standard. The Americans and English use fractions of the English inch, while on the continent of Europe, the French have generally adopted the Paris line, or the millimeter; the Germans using either of these, and sometimes the Paris or Rhenish lines; thus giving five different units of measurement.

There seems to be a growing desire among scientific men in America for the adoption of the decimal system, partly from its extreme convenience, and also to be in accord with a very large class of European observers, who have so long used a system which it seems clear must sooner or later be adopted by our people, not only in this respect, but as to all weights and measures. The fact that our country has not long ago adopted the decimal system, which it was the first to utilize in its currency, is an evidence of a conservatism rather unusual and not generally remarked as a national characteristic.

In connection with this subject of micrometry, it may be interesting to learn that we have in America a gentleman, Professor W. A. Rogers, who has succeeded in inventing a machine for ruling on glass, that has enabled him to rule 120,000 lines to the inch—this being in excess of Nobert's celebrated 19-band plate by about 8,000 lines to the inch. Nobert's process has always been a secret, and his 19-band a wicked thing to resolve, taxing the powers of an objective, as well as the time, patience and temper of an observer to the very utmost degree. Professor Rogers now proposes to rule bands of 240,000 lines to the inch; perhaps he may, but I don't believe anybody will ever see them.

The past year has been signalized in the annals of American microscopy by the meeting of the American Microscopical Congress, a body composed of delegates from all the microscopical societies of the United States, which held its first session at Indianapolis, in August last, the delegate from our society being appointed one of its vice-presidents. It resulted in a permanent organization, called the "American Society of Microscopy," having for its object "the encouragement of microscopical researches in all branches of science." The meeting for the year 1879 will be held at Buffalo, N. Y., in the month of August next.

Another event of great interest occurring during the past year has been the establishment of the *American Quarterly Microscopical Journal*, whose first number appeared in October.

The style of this journal not only in typography, appearance and general make-up, but in the dignity and quality of its material, gives it a very high character, and commends it to the earnest support of every lover of the science it so ably illustrates. Since the demise of the *Monthly Microscopical Journal* of London, which we have sadly missed, for periodical literature on this subject, English readers have had to depend upon the *English Quarterly Journal*, an able but rather heavy production, and the *American Journal of Microscopy and Popular Science*, a lighter but most pleasing and readable exponent of microscopical progress, full of valuable suggestions, and containing within a small compass, notes of everything new in the science in this country.

With the two American journals, and there is room for both, we may anticipate an acquaintance as intimate as we choose to make it with all that is being done within the scope of microscopical science on this side of the Atlantic, and a reference to a great deal beyond it. In other words, we may be fully enabled to keep up with its growth and progress.

I had intended to add a brief statement of the latest researches in biological science with the microscope, but find so large an amount of material in this direction that I prefer to make it the subject of a future paper, to which I can give more time and space than is now at my command.

In conclusion, permit me, gentlemen, to thank you cordially for the confidence and good will I have experienced at your hands during the past year of my official experience, not omitting, at the same time, to express my deep sense of the obligations I have been and am still under to my brother officers, especially the Recording and Corresponding Secretaries and the Treasurer, whose labors for the single benefit of the society I can now fully understand, and hope will be duly appreciated by the society—their only reward.

Respectfully,

HENRY C. HYDE, President.

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—It is very essential where one starts in search of adulterated articles that he should have a thorough knowledge of the genuine. Most of the blunders made by philanthropists and would be reformers are made from ignorance of the subject of which they undertake to speak.

Has the Mammalian Blood-Corpuscle a Nucleus?

By Wm. T. Belfield, M. D., Demonstator of Physiology, Rush Medical College. Read before the Illinois State Microscopical Society.

THE question of the existence of a nucleus in the red blood-corpuscle of mammals has for many years engaged the attention of physiologists. Three considerations suggest such an existence. First, that a nucleus is apparent in all blood-corpuscles not mammalian: second, that nuclei have been recognized in the blood-corpuscles of fœtal mammals; that a nucleus, or the suggestion thereof, can be readily demonstrated in almost all other anatomical elements of mammals. Hence, the deduction has been made that all elements of tissue require nuclei; therefore that the homology of tissues requires that blood-corpuscles should also possess them. Prompted by such reasoning, many observers have sought patiently and persistently to demonstrate the existence of these hypothetical bodies, devising new means and methods when old ones had proved ineffectual. Several times success has been claimed, and not a few observers have asserted their ability to demonstrate these nuclei; but, as a recent contributor to this subject has said: "When their methods and work have been published, and others have followed their directions, errors have invariably been pointed out, and the so-called nucleus has been absorbed in 'optical delusions,' and changes brought about by the reagents used." It is somewhat remakable that the writer of these words, Dr. Stowell, of Ann Arbor, in the same article claims to have demonstrated the nucleus by a new method; or more accurately speaking, claims to have repeated the work of Prof. Boettcher, with confirmatory results. The method is as follows: The corpuscles are bleached by means of a saturated solution of corrosive sublimate in 96 per cent. alcohol. Into 50 parts of this solution one of blood is rapidly diffused. In twenty-four hours the supernatant liquor is poured off and alcohol added. In twenty-four hours more this is replaced by distilled water. The corpuscles are then subjected to staining agents. By this method Prof. Bottcher claims to have seen nuclei in a small percentage of the corpuscles so treated.

Upon reading these observations it occurred to me that the asserted nucleus might be, in part at least, due to coagulation of albumen and extraction of water (which certainly occurs) whereby a central thickening might readily appear, and hence a difference of refraction and apparent deepening of color be observed.

It seemed that if simple bleaching alone were to be accomplished by the reagents used, the same results should follow bleaching by other methods. I therefore instituted a series of observations, whose results I place before you in this paper and on these slides.

Let me, as preliminary, define the nucleus; for much of the difference of opinion of this question results, it seems to me, from a failure to indentify this body. According to Tyson, the nucleus is a mass of bioplasm in the interior of the cell, "more granular, or darker in hue, by transmitted light than the remainder of the cell." * * "This living matter exhibits the important property of being stained by weak solutions of various coloring matters, as carmine, aniline, etc." * * * "and by these means its demonstration is rendered strikingly easy." If then, after exposure to such a solution, we observe in the interior of a cell a sharply-defined mass exhibiting unmistakable color, the remainder of the cell being colorless, we assert the existence of a nucleus; the absence of such differentiation demonstrating with equal force the absence of a nucleus.

With this idea in view, I procured specimens of fresh blood from man, the dog, rat and turtle; exposed the corpuscles to the action of various bleaching agents—chlorine, sulphurous acid, acetic acid, a freezing temperature; then, when the coloring matter had been removed, immersed them in weak solutions of aniline and carmine, and mounted them in distilled water. I was careful to produce, as nearly as possible, identical effects upon all the specimens, using the same solutions for the same periods upon them all. By each method nuclei were clearly demonstrated in the turtle's blood, but in no other specimen was there any differentiation of color. It is true that some mammalian corpuscles showed staining, but that staining was invariably uniform from centre to periphery, proving conclusively the *absence* of a nucleus so far as carmine staining can prove anything.

These slides have been submitted to the scrutiny of several observers, among them Mr. A. F. Atwood, Drs. H. A. Johnson, Lester Curtis and Chr. Fenger. In every instance the result of the observation was announced before the observer was informed what specimen he was looking at, or why his observation was requested. Thus all possible bias and predjudice were avoided, although the names of these gentlemen are in themselves ample guaranty for the fidelity and accuracy of the observations. Therefore it was with great satisfaction that I heard from each an opinion coincident, in all its essentials, with my own. They observed, as I had in a few mammalian corpuscles, points of different refractive power from the rest of the corpuscles, but never any points of different staining.

The question at once arises—How are we to explain Boettcher's nuclei? It would seem to me that they are due to the action of the reagents employed. Certainly both alcohol and corrosive sublimate coagulate albumen, and alcohol extracts water. That we can secure differences of refraction and even differences in depth of staining by reagents I have proved in this way: Mucus is structureless when taken from the mouth; but when treated with Boettcher's fluid it becomes fibrillated. Now the addition of carmine solution causes an uneven staining, the fibrillæ being especially colored. Surely no one would affirm that these fibrillæ consist of nuclear or germinal matter. Yet just as these fibrillæ differ from mucus as it exists in the mouth, so blood corpuscles, after treatment by Boettcher's method, differ from blood-corpuscles in the vessels. This suspicion that Boettcher's nuclei are artificial, receives support from recent discoveries as to the structure of nuclei. In the July number of the *Quarterly Journal of Microscopy*, Dr. Klein relates a series of observations, as a result of which he affirms the nucleus to consist of a fibrillar network imbedded in which is a ground substance; that this intra-nuclear network is continuous wlth a similar intra-cellular network; that nucleoli are merely thickenings and shrivelings of these fibrils. The natural shriveling effect of alcohol might readily produce a pseudo-nucleus in a blood-corpuscle from condensation of this intra-cellular network.

Now as to the argument that the homology of tissues demands the existence of a nucleus in the red corpuscle. Does this homology require nuclei in the enamel rods and superficial layers of the epidermis? Certainly they have never been demonstrated. Indeed a nucleus would be in these situations superfluous, for the functions of the nuclei are, as we understand it, growth, nutrition and reproduction. Since neither of these processes is required of enamel or superficial epithelium, nuclei are here unnecessary and therefore absent. Now the function of the mammalian blood-corpuscles is only, so far as we know, the transportation of oxygen, a purely chemical process performed as well without as within the body. The hæmato-crystallin, like other ferrous salts, is capable of uniting with oxygen, and again, under other circumstances, of imparting that oxygen. Nutrition, growth and reproducture are, to the best of our knowledge, foreign to the matured corpuscle; hence a nucleus is unnecessary and we would, *a priori*, expect its absence. This proposition is advanced, not as an argument, but simply to show the fallacy of the argument based on homology.

It would be improper to conclude this article without reference to the work of the late Prof. Freer, of this city. By the use of reflected light, Prof. Freer demonstrated in many blood-corpuscles a central thickening, but failed to prove any corresponding difference in chemical composition, vitality or function—that is, failed to prove the existence of a nucleus. Hence, while authorities universally admit his demonstrations as to contour, they as universally restrict his demonstration to contour. If thickness constitutes a nucleus, then the red corpuscle has a nucleus all around its periphery as well as in its centre.

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A Fine Diatom.

BY W. W. RINER.

A FEW years ago the writer was the recipient of a small quantity of cleaned diatoms, from Prof. H. L. Smith, of Geneva, N. Y., that were collected, if I mistake not, at Waltham, Massachusetts, in which were many very fine specimens and one especially beautiful in outline, that was afterward found to be equally so in detail, viz., *Surirella Limosa.* Shortly after receiving it I sent samples of it to J. Edwards Smith, then of Ashtabula, Ohio, who at that time thought it new, and named it *Surirella Rinerii.* Samples were also sent to Charles Stodder who did not at that time recognize it, but he tells me in a recent letter that he and Prof. H. L. Smith discussed it and arrived at the conclusion that it was *Surirella Gautamalensis*, but recently I sent a specimen to Prof. H. L. Smith, and he gives it the name *Sur. Limosa*, of Bailey, and we conclude he has found some authentic reference since his talk with Mr. Stodder. Mr. Stodder also tells me he has recently received from New Albany, Indiana, a specimen of the same diatom gathered there, showing it is not peculiar to one locality. I have never had an opportunity of examining the living specimen, but judge it is very striking from the appearance of the frustule. It is large, four one-thousandths of an inch in width, by seven-thousandths long. Its general outline is oval resembling the outline of an egg, slightly curved on the outside and correspondingly concave on the inside, with a rather distinct but not prominent costate line; but the most interesting characteristic is its fine striation, which is as close, or closer, than *Frustulia Saxonica*, and very much finer, making it, in balsam, a test that is only equalled by *A. pellucida* so far as my experience goes, and with my new Spencer's 1 6th, I have found a resemblance to hexagons. My friend, Mr. G. W. Morehouse, of Wayland, N. Y., says, with a 1-10th in his possession, he resolves it into hexagons. He used monochromatic sunlight; and I think Prof. J. E. Smith got similar results. On the whole it is a rarely beautiful diatom and a test of more than ordinary difficulty.

Greene, Iowa, March 25, 1879.

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A Hot-House Pest, and How to Get Rid of It.

Paper read before the Buffalo Microscopical Club, March 1879, by Henry Mills.

ABOUT the 12th of December, 1878, my attention was called to some large excrescences found growing on the root of a cucumber vine in a hot-house that I frequently visit. I had no idea of the cause of these gnarled and deformed roots, so took one or two home to see if I could find out with the aid of the microscope. My first attempt was by cutting longitudinal sections of the ball which afforded only partial success. I soon found, however, that my knife had run into something differing from vegetable. There was evidently animal matter, as the field was strewn with small oil globules, and other matter that did not mix with the fluid in which my sections were held. The fluid used was glycerine and water, which may account for my failure to observe animal life. I do not think animals can move freely where much glycerine is present. Besides the evidence of the presence of animal life referred to, I found some curiously formed cells, and now and then a small hole just as I should expect to find if I knew there was a small borer inside. After a few days, I made another trial, and was more successful as the sequel will show. I determined to be more careful in making my sections. I cut several at different angles and laid them on the slide with water only as a medium, and found at first sight the same evidence of the presence of animal matter, and the same distorted, unnatural, but somewhat beautiful cells. After a few more sections I came to a worm, which I recognized as an *anguillula* from its length as compared with its width, and the peculiar wriggling motion which all of that family have. I found two kinds, or rather two of the same kind in different stages of growth. By reference to the plates in the "Micrographic Dictionary," I was enabled I think to identify them as *Anguillula Tritici*. The worms were similar to those marked 6*d* and 6*e*. Also, I found ova corresponding to 6*a* and 6*b*, plate 16, New Edition. I was unable to find the full grown animal at this time. *One* that I did find had what appeared to be ova, extending the whole length of its body just as you will find it marked 6*d* of the plate. In about a week from this time I made another visit to the hot-house, and took from the soil in which the cucumbers were trying to grow, a very small piece of a partially decayed leaf, which presented the appearance of being covered with a fungus. I wrapped it in dry paper, took it home and examined it carefully. Instead of fungus as I had supposed, I found the cells, ducts and veins of the leaf laid bare and so thoroughly cleansed that they had the appearance of mildew. On a small particle of the soil attached to this leaf I found quite a number of the full grown *Anguillulæ*. Thus I was forced to the conclusion that the mass of earth in which this unsuccessful attempt to grow cucumbers was made, was alive with *Anguillulæ Tritici* or some species so near it that the difference could not be made out in the short time that I have had for observation. By reference to the *Gardener's Chronicle* (an English paper) I find that the editor of that paper discovered the same animals in a root of cucumber vine similarly diseased to the one above, as early as 1855. He did not call them by the proper name, but his drawings correctly represent the animals and ova that I found. The popularly known eels in vinegar and paste, also those found sometimes in moss, and occasionally in our Niagara water belong to the same family.

The *Anguillula Tritici* is frequently found in the blighted ears of wheat, also in the stalks of the young wheat plants. The "Micrographic Dictionary" says they will revive after having been kept in a dry state for five years. This statement is doubted by many, and is a point well worthy investigation. On the 26th of Foburary, 1879, I had put into my hands from the same hot house or the greenhouse adjoining, a good sized root of a fuchsia, which presented an appearance similar to the root of the cucumber plant. The knots varied from the size of a No. 1 shot to that of a large pea or bean. I cut nearly a hundred sections before finding any life. I could find the holes as if made by a borer, and the cells were deformed in much the same manner. One peculiarity of this root was an extraordinary number of bunches of raphides. Every section was full of them, so that I had to clear my slide two or three times to be able to continue my observations. To what extent they were the the result of the disease of the root I had no time to investigate, as I was anxious to find the living animal, if present, so I kept on cutting section after section, till at last I hit upon the right spot, and was well rewarded by the discovery of a goodly number of the full grown worms. I examined them carefully, worm after worm, but could not identify them with anything marked in the "Micrographic Dictionary." They did not resemble either *A. Fluviatilis or A. Aceti.* The body was short and thick like *Aceti*, but it had no such internal structure. The pharynx was strongly marked, and a great distance from the mouth. *Fluviatilis* is too tapering, and the mouth too large in proportion. I find that these entozoa infest a great many articles of food. The eels in vinegar are well known, and many years ago had become such a nuisance that the fruit growers in many states complained of their inability to make apple vinegar profitably, and for this reason many had abandoned its manufacture. The British manufacturers have all suffered from the same cause. At length the discovery was made that by adding a very small quantity of chemically pure sulphuric acid, the presence of animal life was prevented, at the same time the vinegar was considered perfectly wholesome. An act of the British Parliament allowing the use of the acid was passed several years ago. Mr. Thomas Taylor, of the Argricultural Department, Washington, D. C., in his report for 1871, says that the *fruit* of a pear tree growing in the grounds of the department became diseased, and had a very singular appearance. He examined it in various ways, and discovered small snake like forms of the *Anguillulæ*. After many experiments on the decayed and diseased parts of the pear as to the best method of detecting the entozoa, and of separating them from the cellular matter, he was enabled to secure them alive in great numbers. He took a little of the pear and wrapped it in muslin, and pressed out the juice, which being thinned with water was found to contain them in great numbers. He found also in these pears a great amount of fungus spores and branched mycelium. Whether the entozoa were the cause or the effect of the disease in the pear, or whether the fungus first, and then the entozoa, would be interesting to find out. Having made these discoveries in one fruit he was induced to try others also. Diseased peaches and even the trophy tomato (diseased) was infested with them to a large extent. The close resemblance of these creatures with the *Trichinæ Spiralis* have lead naturalists to place them in the same class—Entozoa: Family Nematoidæ. *Aguillulæ* are said to be oviparous and viviparous, while the *Trichinæ Spiralis* are said to be viviparous only. *Trichinæ* became cased in a strong calcareous skin, while *Anguillulæ* are destitute of that protection, and if exposed on a slide to the rays of the sun seem to melt and spread out. One point of difference worthy of consideration is that the large end of *Anguillula* is the head, while all writers on the subject of *Trichinæ* place the head at the smaller end. *Anguillulæ* are thus described: Body filiform, narrowed at the ends. Mouth naked, round, terminal. Anus subterminal. Tail of male, either naked, or furnished with a membrane. Tail of female conical acute. Mouth succeeded by an oblong cavity—the pharynx. Stomach top shaped or spherical, furnished with a kind of dental armature. If this article should fall into the hands of any whose hot-house or greenhouse is infested in the same way as the one above referred to, I would recommend a much more plentiful use of fine sand in the soil, and the application of a very weak solution of carbolic acid to the roots.

The gardener in charge followed this advice, and now has no trouble in growing the finest cucumbers.

Food Adulterations.

A Paper read by Prof. Sharples before the Boston Microscopical Society.

ADULTERATION, or impurities of food may be divided into three classes. First deleterious adulteration; these are such as are directly injurious to health, such as red lead in cayenne pepper or chromate of lead in mustard. The second class, and by far the largest, are what may be called fraudulent adulterations. These injure the pocket rather than the health. This class does not properly come under the notice of the health officer, but is a fraud upon the general public, which should be taken notice of by mercantile associations. This class may be illustrated by such articles as flour in mustard, chicory in coffee, and terra alba in cream of tartar. The third class is what may be called accidental. In many instances of this class it is the duty of the health officer to interfere and confiscate the goods, but the simple deprivation of the articles is generally sufficient punishment. In other cases in this class the presence of the impurity arises from methods of manufacture, and if it does not exceed a certain limited amount it may be neglected, and is generally neglected in trade. For instance, cream of tartar generally contains tartrate of calcium; if this does not exceed six or seven per cent the article passes as pure. If it runs much higher the article is rejected or passes as a low grade with a reduction in price. Belonging to the same class is the small amount of sand oftentimes found in Cuban sugars, and in general all the impurities in our every-day food which are present, not from design but from some imperfection in the process of manufacture.

The first operation in our search for adulteration is to make ourselves thoroughly acquainted with the genuine article, and in order to make ourselves acquainted it is not sufficient to merely read the accounts we may find in the books, but we must take the articles to our laboratories and submit them to every test that we can devise. Perhaps the most difficult branch of adulteration that the chemist has to deal with is the sophistication of ground articles. So long as the article is in its natural state but little trouble is experienced; we can readily detect any change made in it, but when ground we have no resource but microscope or chemical tests. Many substances which contain starch grains can be readily recognized by the microscope. Flour in mustard at once shows. The various arrowroots are readily distinguished by this means. A few weeks ago I had occasion to examine flour that was suspected of adulteration. Washing with water served to show that one portion was much heavier than the remainder. Microscopic tests at once showed that this heavier portion was rice flour. In this case the usual order of adulteration was reversed, and a more expensive article was added to a cheaper one in order to raise the grade of the whole. Much has been said and written in regard to the adulteration of coffee, but so far as I know no one has yet found in coffee any article more injurious than the coffee itself. Chicory may be readily distinguished from coffee by the fact that when the ground article is thrown into the water, if chicory, peas, rye or Indian corn are present, they rapidly sink to the bottom, while the coffee floats. The adulterations also quickly impart to cold water a brown color, while coffee colors it but slowly. Cream of tartar is, perhaps, the substance next on the list at present which gives us the most trouble. The common adulterations of this article are rice flour, which is easily detected by the microscope and by turning blue when treated with tincture of iodine. *Terra alba* or gypsum, which is but sparingly soluble in hot water, but which may be dissolved with muriatic acid; when this is present the solution gives a precipitate with chloride of barium. It is also readily recognized by the microscope when polarized light is used. Tartrate of calcium,—this is almost insoluble in boiling water, is soluble in hydrochloric acid, and gives a precipitate with ammonia and oxalate of ammonia. The quantity of this must exceed seven or eight per cent before it can be reckoned as an adulterant. Milk is another subject about which the controversy seems to be endless. The list of adulterations found in the books is a long one, but when thoroughly investigated it seems to narrow down to about two or three. Water is added in considerable quantities, a little burnt sugar is then added to bring up the color. One or two other substances are sometimes classed as adulterants, the use of which can hardly be condemned. In hot weather many of the milkmen add a little baking powder or bicarbonate of soda to the milk, or a little salt; both of these substances tend to prevent the milk becoming sour and coagulating. A trace of chalk is also sometimes used for the same purpose. The fraud most extensively practiced in this vicinity at the present time is the sale ' skimmed for whole milk. This fraud can easily be detected by the microscope. Milk that has been skimmed is comparatively free from large fat globules. Sugar as sold here is as pure as sold at any place in the world. Candy, at the present time is made largely of glucose, which is manufactured from corn starch. I see no objection to the use of this, provided it is well made and purified.

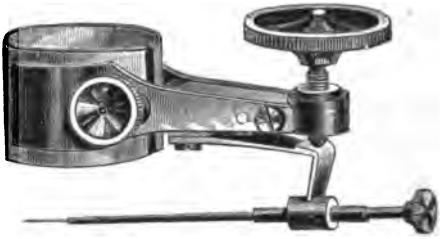
In conclusion the professor warned the members against hasty conclusions in regard to this subject. Persons often take a look through their microscopes at articles of food, and rush into print their discoveries, when a few hours' patient investigation of genuine articles about which there could be no doubt, will serve to show them that they were mistaken in their suppositions. Young students fresh from college are apt to find things much worse than those who have studied the subject for years. But I would not for this reason discourage a full investigation of the subject. The more thoroughly we become acquainted with it the better able we will be to detect and secure the punishment of fraud where it does occur.

The Mechanical Finger.

THIS very convenient device, a cut of which is given below, is intended for a large range of work such as ordinarily comes under the hands of the "working microscopist," although it is perfectly adapted to the fine work of the dilettante. This particular form was designed by Dr. W. B. Rezner, of Cleveland, Ohio, and is adapted to any microscope, whereas the costly forms heretofore made by the opticians were only designed for microscopes having sub-stages.

In use, the sleeve, seen in the figure, is passed up on the objective far enough to have firm bearing, and so that the bristle point will be in focus when depressed nearly to its limit; it is clamped in place by the small thumbscrew. The wire in which the bristle is carried is drilled at the point to receive it, and slides easily but not loosely through a small sleeve, so that the end of the bristle can be brought into the centre of the field when in focus, and the wire can be revolved so as to view every side of the object picked up by the bristle. The wire stands at a greater angle than is shown in the cut, and the vertical part of the spring is not so long as figured.

When using the finger the bristle is first raised by the micrometer screw till so far within focus as to be nearly or quite invisible, then the objective is focused on the slide of material and the desired object sought for; when found, it is brought to the centre of the field, and the bristle point is then lowered by the screw till it touches the object, which usually will adhere to it at once, but sometimes several trials may be necessary; when it does adhere to the bristle, the objective is raised clear of the slide, and the object may be examined by rotating the bristle wire by means of its milled head.



MECHANICAL FINGER.

The object may in many cases be thoroughly examined without lifting it from the slide, by pushing it about with the bristle, or even rolling it to and fro under the bristle, by moving the slide by hand or stage movements.

When used to mount selected objects, these are picked out one by one from the mass of material, and transferred to a drop of distilled water on a clean slide; when sufficient are secured, the drop is dried over the spirit lamp and the slide mounted in the usual way. But if the objects selected are to be mounted in lines or symmetrical figures, a more elaborate process is necessary. To do this work, an ordinary slip is ruled in the centre with a grating of crossed lines as closely as possible, and another is ruled with concentric circles as close as can be done by hand. A writing diamond and the turntable will do the work if the operator is reasonably skilful. It is also convenient to rule the slip on which the material is placed in squares of about 3-16 inch, and to number them with the writing diamond.

The cover on which the mounting is to be done is spread with a film of gelatine in thin solution, on which when dry the mount is placed. The gelatine solution should be made with distilled water and filtered, and should not be used after it has begun to ferment, as it sometimes will. To spread the film on the cover use a *fine* glass tube or coarse needle dipped in the gelatine solution and wiped flat across the cover *once*, having first well warmed the cover. The film quickly dries, when the cover is placed in the centre of one of the ruled slips, with the gelatine film up, using the square grating for lines, letters, etc., and the other for circles. The cover may be held in its place by a minute touch of wax at each side, and must be protected from dust by a cover of some kind when not on the stage.

A diatom or other object having been selected, the bristle point is brought down to it, and when it adheres the point is raised well within the focus, and then the microscope body is racked back a little, the slip of material removed and that bearing the gelatinized cover substituted on the stage; the objective is then focussed on this, and the centre found, when the bristle point is lowered into focus and the object deposited on the cover, and if necessary pushed into its proper position. The bristle is then raised (and until some practice has rendered the operator skilful, it is best also to rack back the objective a little), the slip removed and covered up, the slip of material replaced and another object selected, and the process repeated till the desired arrangement is complete, when the slide should be mounted at once, or accidents will be sure to spoil it. When all the diatoms are in place, breathe gently on the cover several times, warming it between times over the lamp; this fixes the objects in the gelatine and prevents their washing out. The cover should now be carefully detached, warmed, and a drop of pure turpentine placed on the objects, and placing the microscope vertical, the disappearance of air from the objects is watched; when this is seen to have taken place, a little thinned balsam is put on, heated a little over the lamp, and a cleaned slip is warmed and applied to the cover so as to pick it up by the balsam; the bits of wax enable the cover to be placed in correct position, and its centricity can be secured by turning a ring of ink the size of the cover on the under side of the slip on which it is to be mounted; this can be rubbed off when the mounting is done.

Minute objects in fluid can of course only be examined with the mechanical finger when the microscope is placed in a vertical position, but when working with dry material the microscope can be inclined as in ordinary work. It is important always to avoid jarring the microscope, since the object may be lost at the last moment by this cause, but it is sometimes necessary to tap the bristle wire gently with a small stick or rod, to detach an object which adheres obstinately to it.

The mechanical finger is best used when placed directly in front of the microscope body, the bristle then points (in the field) from the operator, and pushing the slide or stage apparently pushes the bristle, thus the movements of the hand seem natural to the eye.

The "bristle" may be a finely pointed bristle, a hair, a wasp's sting, a horsehair, or even a fine sliver of whalebone, but for diatoms, butterfly scales, etc., I find the tip of a cat's whisker most satisfactory, the hair or bristle should project about a quarter of an inch from the end of the wire, and is cemented in the wire with wax. A bristle may be finely pointed by laying it on glass and shaving down with a razor, and finally grinding it with the finest of emery paper by rolling between the fingers or on glass.

As a single instance of the utility of the mechanical finger, I may state that after long watching for the *Actinocyclus Niagara* in the filterings of water from Lake Erie, and examining hundreds of samples, I was at last rewarded by finding a single valve in a late gathering of the crude filterings, in water. By putting on the finger I was able to pick out and preserve this solitary valve and mount it, and have found no more since. Without some such device it would have been impossible to rescue this single valve from the mass of material.

C. M. Vorce.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Terms—$1.00 per year.
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Important Notice.

We can no longer supply complete sets of Volumes I and II in sheets. We have on hand a few complete copies of Vols. I and II, handsomely bound in cloth, with gilt title, price $1.25 each. Also a few copies of Vol. III, with full margins, bound in cloth, for $1.50 each.

As we desire to place a *complete* set of the Journal at the disposal of our subscribers at a moderate rate, we offer Vols. I, II, and III, bound, and the numbers for 1879, as issued, for $4.00 *net*.

Those who wish to have their numbers bound, can do so for 35 cents per volume. Mailing 12 cents additional.

Foreign Subscribers.—Subscribers in Great Britain and the Continent of Europe will be supplied at the rate of $1.20, or 5 shillings sterling per year, postage paid. Vols. I and II, bound, will be sent for 6 shillings each, postpaid. Vol. III, postpaid, for 7 shillings. Vols. I, II and III, bound, and the numbers for 1879, as issued for £1. British postage stamps received at full value for subscriptions and books in sums of 12 shillings or less.

The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

Chas. Stodder, 131 Devonshire Street, Boston.
S. E. Cassino, Naturalists' Agency, Salem, Mass.
J. G. Langguth, 48 Madison St., Chicago, Ill.
Jas. W. Queen & Co., 924 Chestnut St., Phila., Pa.
W. H. Walmsley, 921 Chestnut St., Phila., Pa.
Fred. Wagner, 41 West Fifth St., Cincinnati, Ohio.
Wm. M. Rebasz, Rochester, N. Y.

The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the American Journal of Microscopy. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

Removal.

FOR many years our quarters at 176 Broadway have been too small for our business, and we have been in many respects subjected to great inconvenience thereby. The difficulty and annoyance of moving at a busy season of the year, has hitherto prevented us from making a change, but at last we find ourselves compelled to secure more room and additional facilities. We have therefore leased very large and commodious premises at No. 14 Dey street, about one block from our old stand. Our office and reception rooms will be situated on the second floor (the one immediately over the store), and we propose to have them fitted up in very attractive style.

Please remember the change of address after the first of May.

◆

Prof. J. E. Smith on the Microscope.

THE numerous and important advances which have been made in objectives since the announcement of this book, necessitates the re-writing of a large portion of the work. Its issue may now be expected very soon.

◆

The New Postal Laws.

AFTER the first of May, the new postal laws take effect, and it will gratify all our readers to know that microscopic slides and apparatus may be sent by mail at package rates—one cent per ounce. It is not claiming too much for us to say that this result is largely due to the efforts and influence of this journal. Ever since the postal authorities so interpreted the old law as to exclude everything having the least bit of glass in its composition, we have been incessant in our efforts to effect a change. When the new law, as drawn up by a clique of Boston publishers who assumed to legislate for the various interests of the entire country, also excluded glass, we called to it the attention, not only of all microscopists, but of all the legislators with whom we had any influence. As a member of the United States Board of Trade, the editor of this journal spoke and wrote in favor of a most liberal law, and so far as microscopists are concerned, the result, to whatever agency it may be due, is highly satisfactory.

It unfortunately happens, however, that the influence of the New York, Boston and Philadelphia post-offices has been sufficient to retain that relic of barbarism, the special rate on city publications. As many of our readers probably do not understand this curious absurdity, we will explain: Under the present law, a monthly journal published in Philadelphia may be mailed to subscribers in New York at the rate of three cents per pound, but if sent to subscribers in the city where published the rate is eight cents per pound! That is to say, the postal authorities are willing to transport a pound of journals from Philadelphia to New York, or even to New Orleans or San Francisco, and deliver them to subscribers, for three cents (two cents after the first of May), but if sent from one part of Philadelphia to another, or one part of New York to another, the charge is eight cents per pound!

Let us be thankful for what we have received, however, and hope that at no distant day, we may be able to induce our legislators to give us postal laws as liberal and as enlightened as those of the so-called despotic governments of Europe.

American Society of Microscopists.

A PRELIMINARY meeting of the Buffalo Local Committee was recently held in that city for the purpose of organization, in view of the necessary preparations for the August meeting of this association. Dr. H. R. Hopkins was chosen President of the Board of Local Management, and Jas. W. Ward, Secretary. A committee was also appointed to consider and propose to a subsequent meeting of the Board, a general plan of action, and a proper division of the work amongst the several necessary subcommittees.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the differeht Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—A regular meeting of this society was held on the evening of Dec. 6, 1878, Mr. J. D. Hyatt, the president, in the chair.

The following donations were received: From W. W. Riner, Greene, Iowa, one slide of arranged diatoms, and one of Surirella limosa; from R. Hitchcock, one slide of Merismopedia convoluta, and one slide of polyzoa; one copy of "Report of the Curator of the Museum of Comparative Zoology, of Cambridge, Mass.'

On motion the matter of micrometry was referred to the Board of Managers, with instructions to report to the society what action they deem it advisable for the society to take. A circular letter from the Troy Scientific Association was read regarding this subject. It was resolved that the Secretary and Committee on Publications be instructed to furnish reports of the proceedings of the society to any journal applying for it, for the purpose of publication.

A regular meeting of the New York Microscopical Society was held on the evening of Dec. 20, 1878, President Hyatt in the chair.

The Board of Managers reported that they do not consider it expedient that the society should take up the question of the micrometer at the present time.

Messrs. Wm. R. Mitchell and Chas. F. Eichorn were elected active members, and Mr. Frank Crisp, of the Quekett Club, of London, an associate member.

A report of the Botanical Section of the Society was made by Mr. W. C. Hubbard.

Amendments to By-Laws, in Articles 1, 6 and 10, relating to order of business and payments of dues, were made.

The annual election of the New York Microscopical Society was held on the evening of Jan. 3, 1879, Mr. Hyatt, the President, in the chair.

On motion, the President appointed as a Nominating Committee, Messrs. Hubbard, Wall and Yates. They made their report, when the voting for officers took place, which resulted as follows:

President—J. D. Hyatt.
Vice-President—A. A. Julien.
Recording-Secretary—C. S. Shultz.
Corresponding Secretary—W. H. Mead.
Treasurer—W. C. Hubbard.
Librarian and Curator—J. Warnock.
Auditors—Messrs. G. I. Whitehead, J. L. Wall, A. J. Swan.

The annual meeting of the New York Microscopical Society was held Jan. 17, 1879, President Hyatt in the chair.

The President made a favorable report on the state of the society. He stated there were 32 active, 8 associate, and 3 honorary members.

The Treasurer made his report.

Messrs. Julien, Deems and Mead were appointed a committee to find suitable rooms for this year's meetings.

R. Hitchcock. Recording Secretary.
[Abstract by C. S. Shultz.]

The annual reception of the New York Microscopical Society was held informally in the Society's rooms, Feb. 7, 1879.

The President, Mr. Hyatt, who had been reelected, in lieu of his valedictory, read an interesting paper on "The Tongue of the Honey Bee," stating in substance that he had determined the exact structure, by numerous thin sections, which, when examined by transmitted light, showed that entomologists had fallen into many errors respecting the true character of this organ.

The new officers took their seats, when Mr. Hitchcock exhibited one of the new large pattern stands made by Mr. Bulloch, of Chicago.

Donations of diatomaceous material were received, with thanks, from Mons. E. Mauler, of Travers, Switzerland, through Messrs. Hitchcock and Wall.

There were present as visitors, Mr. Hanaman, Secretary of the Troy Scientific Association; also Messrs. Besson, Cooper and Rugge.

The meeting then adjourned to view the numerous interesting objects (both living and on slides) that were placed under the microscopes for exhibition.

The regular meeting of the New York Microscopical Society was held Feb. 21, 1879, President Hyatt in the chair.

There were received "Bulletin of Comparative Zoology," Cambridge; also 50 copies of the "Transactions" of this society, from Messrs. Hitchcock and Wall, for all of which the donors were tendered the thanks of the society.

Mr. R. Hitchcock read a short paper on "Some of the Lower Forms of Fresh Water Algæ." He referred more particularly to the Palmelaceæ He stated, among other things, that, on account of the changeable form of these plants, much confusion had resulted. He gave the distinguishing character of the plants known as Protococcus, and several others, as they appeared to him. He exhibited under a microscope a specimen of Dictyosphaerium, which he had been watching for the past few months.

Mr. C. Van Brunt followed him on the "Preserving and Mounting of Algæ," etc., and in his experience had found that a cell made of asphalt and gold size, in which the algæ or other plant had been placed in carbolated water, and the cover sealed with hard balsam in benzole, covered with size, etc., that such mounting had been well preserved for 18 years in his hands.

The regular meeting of the New York Microscopical Society was held March 7, 1879, Vice-President Julien in the chair.

The Committee on Excursions and Field Work reported their list of places to visit on alternate Saturdays during the summer, and, on motion were empowered to print the lists and make all arrangements.

Mr. M. R. Cooper, of this city, was elected an active member.

Dr. R. H. Ward, President of the Troy Scientific Association, was present as a visitor, and invited the members to attend the next meeting, at Buffalo, of the American Association of Microscopists, of which he is the President.

The meeting adjourned to view some test objects under a Tolles 1-10th, and Woodward prism as a means of illumination, as shown by Mr. Hitchcock. Other interesting objects were exhibited by various members.

Chas. S. Shultz, Recording Secretary.

Rochester (N. Y.) Microscopical Society.—The Rochester Microscopical Society met at the Free Academy, Monday evening, March 10th, President Lattimore in the chair.

After the reading of the minutes, the President addressed the Society on the subject of Practical Micrometry, exhibiting, in the course of his remarks several pieces of apparatus, and describing in detail the methods followed in obtaining minute measurements.

A communication from the Microscopical Section of the Troy Scientific Association, was read by the Secretary, and on motion of Mr. Fisher a committee of three—Messrs. Fisher, Bausch and Rebasz—was appointed by the President to nominate one member to represent our Society on the proposed national committee.

This committee immediately reported the name of President S. A. Lattimore, and on motion the report was unanimously adopted.

Mr. Rider called the attention of the Society to the necessity of better arrangements for the exhibition of objects, and read few extracts from Mr. Fell's article on "Microscopic Soirees" in the January number of the AMERICAN JOURNAL OF MICROSCOPY. He recommended the purchase of a supply of revolving tables, and, on motion of Mr. Matthews, a committee of four was appointed to procure them.

A resolution requesting members to invite their lady friends to the society's meetings was adopted.

The following appointments for the next meeting (April 14) were made by the President:

Stated paper of the evening, Rev. Myron Adams; Committee on Microscropes, etc., Messrs. French, Rebasz and Morgan.

Under the head of nominations for membership, Professor Lattimore presented the name of Miss Grace Anna Lewis for honorary membership. Miss Lewis was unanimously elected.

The following were made active members: Drs. Brownell, Weigel, Walker and Doolittle, and Messrs. Lansing, Ellis and Cronise.

At this and the previous meeting Mr. Rebasz—through the courtesies of the publishers—presented members with copies of the AMERICAN JOURNAL OF MICROSCOPY, and the YOUNG SCIENTIST.

At the social, Mr. Streeter exhibited slides of diatoms; Dr. Line a number of sections of teeth and stained tooth-pulps; Dr. Farley sections of diseased kidney.

Buffalo Microscopical Club.—At the last annual meeting of this club, held at the Grosvenor Library rooms, in February, the following officers were re-elected for the ensuing year:

President—Dr. H. R. Hopkins.

Secretary—James W. Ward.

Advisory Board—Prof. D. S. Kellicott, Henry Mills, George E. Fell.

After the election, Prof. Kellicott made a brief and encouraging verbal report on behalf of the Advisory Board, indicating the amount of work done by the members during the past year, in the field, at home, and in the club room, and the Secretary read the following report:

The continued activity and material progress of the Buffalo Microscopical Club through another year of its quiet existence, gives occasion on this anniversary evening, for many pleasant reflections and mutual congratulations throughout our very harmonious fellowship. Refraining from all unnecessary obtrusion of ourselves or our work, upon the public attention, we have steadily and with quite the average success, pursued the work we have professedly taken in hand, declared in our modest constitution to be, "the systematic prosecution of microscopical investigations," and feel that we are able to show as creditable a record and certainly to enjoy as profitable a reminiscence connected with our prescribed department of inquiry and research, as other kindred associations. At all events we have pursued a definite purpose, to us of unwearying interest; we have found pleasure and instruction in our regularly sustained meetings, and we may even venture to believe that by the aid of our cunningly devised appliances, we have in not a few interesting instances succeeded in urging nature into the disclosure of some of her long concealed mysteries. If we have been betrayed at times into the confession of overwhelming emotional astonishment at some of the disclosures thus graciously vouchsafed us, we may, on the other hand, indulge in the retaliating fancy that we have, perhaps, to an equal extent astonished nature by our persevering impertinence and audacity.

Of special papers read before the club and notes and memoranda of personal observations and discoveries, we have already on file, quite a presentable list; and if we had in our treasury as many dollars as we have had unexecuted plans in our heads, we should be able to communicate to the world what we have ourselves acquired, and could put forth a very creditable and instructive volume. As it is, however, the alternative is not without its advantages. We have some content with our own progress; we look forward to still greater achievements, and await opportunities of making our discoveries available in directions of practical utility. And this after all is the main reason for our existence, and should be the motive of all our investigations. Our position in the field of microscopical inquiry has been flatteringly recognized by the recent seclection of this city as the place of meeting of the second session of the American Society of Microscopy, which will take place in August next. We believe with great confidence that this announcement will prove gratifying to every citizen of Buffalo. The institution is a national one, its large and comprehensive fellowship extending from the Atlantic to the Pacific, and embracing many of the most distinguished original and practical workers in the various branches of natural science, belonging to our country. The post of honor in the circle of its annual conferences, being accorded this year to Buffalo, it becomes us to bear in mind that it is an honor not to be accepted without a more substantial and serviceable equivalent than mere good will and self gratulation. It is a matter that demands our serious and instant attention. Surely no member of this club will fail to see that here is an occasion that invites the active participation of every associate. But the responsibility reaches further, and preliminary steps have already been taken in co-operation with representatives of kindred associations in our city to insure intelligent and systematic action in furtherance of this creditable project on the part of the entire community.

It will occur to all who give the subject any consideration, that having accepted, as citizens of Buffalo, the pleasing position and consequent duties of hosts to this important and learned convocation, it devolves upon us by common assent, to do everything in our power, as naturalists and as citizens, individually and concurrently, to make the occasion pleasant and successful in all respects. This, after all, will be only maintaining the reputation this city already enjoys for its prompt and open-handed hospitality. It would seem but a reasonable expectation that the purposes and efforts of this club and the kindred organizations of this city, with which, for the consummation of this enterprise, it is associated, to promote the comfort and enjoyment of those who may attend this conference, will be cordially sustained, socially and materially, by the concurrence and aid of all our fellow-citizens.

Fellows, it seems, then, that we cannot live unto ourselves alone. We enter upon another year of our especial work with encouraging retrospection; with renewed confidence in the stability and usefulness of our organization, and withal, as we have seen, with an enlarged responsibility; a responsibility which, being voluntarily assumed, it will in no wise do for us to evade or forget.

The following are among the papers that have been presented during the past year:

By Dr. L. H. Smith—"Uric Acid."

By Dr. Ducke—"Preparation and Mounting of Delicate Soft Tissues."

By Dr. Woodward—"Comparative Merits of English and American Objectives."

By Dr. Blackham of Dunkirk—"Angular Aperture of High Power Objectives."

By Dr. E. N. Brush—"Preparations of Sections of the Brain."

By Mr. G. E. Fell—"First Meeting of American Society of Microscopy."

By Prof. Kellicott—"Undescribed Parasites on Fish in Lake Erie."

By Mr. J. W. Ward—"Study in Pathological Histology in Reference to the Cancer Cell."

By Prof Kellicott—"Species of Marine Crustacea in the Niagara Water."

By Dr. Barrett—"Weights and Measures and Micrometrical Measurements."

On motion of Prof. Kellicott, the report was accepted and ordered to be published.

The President then read his annual address embodying some practical thoughts on the use of the microscope in the diagnosis of consumption: a carefully prepared and instructive paper, which was enthusiastically applauded by the meeting.

James W. Ward, Secretary.

San Francisco Microscopical Society.—The annual meeting of the San Francisco Microscopical Society was held Thursday evening, January 13, President Hyde in the chair.

Professsor Ashburner presented the society with seven slides of diatoms, finely cleaned and mounted by himself, from Santa Monica, Cal.; Richmond, Va.; Maryland; Mead's Pond and Lily Pond, Waltham, Mass.; Isles of Shoals; and Patuxent River, Md. The Santa Monica silde contains many of the forms enumerated by Mr. Charles Stodder in his recent paper on that interesting earth.

Mr. Charles W. Denison donated seven slides of minerals, opaque, mounted by himself.

The election of officers for the ensuing year being now in order, was proceeded to, and resulted as follows: President, H. C. Hyde, Esq.; Vice-President, Colonel C. Mason Kinne; Recording Secretary, Dr. S. W. Dennis; Corresponding Secretary, Mr. Charles W. Banks; Treasurer, Mr. G. L. Murdock.

The annual address of President H. C. Hyde, embodying the reports of the other officers of the society, which will be found elsewhere, occupied the remainder of the evening.

Wellesley College Microscopical Society.—The regular meeting of the Microscopical Society of Wellesley College was held on the evening of March 15. The President, Miss Cook in the chair.

After the reading of the minutes, Miss Dickinson read a paper upon Animal and Vegetable Hairs—their structure, differences and uses. She described the results of her own experiments and measurements, illustrating by blackboard drawings, and by slides placed under some ten microscopes. The vertical section of the scalp, showing bulb of human hair with oil gland, and perspiration gland, also horizontal sections of the same were prepared by Miss Nunn, Professor of Biology.

Miss Beattie presented a paper on Bacteria, stating, in the light of recent experiments, the present position of the subject of spontaneous generation, and of the connection of Bacteria with putrefaction and infection. The various test experiments of investigators were described with clearness, and the results and inferences weighed. Some of the forms of Bacteria which had come under her own observation in various preparations and infusions, were described. Several slides were exhibited showing Bacteria in sheep's blood. With her apparatus all before her, Miss Whipple then gave a demonstration of the method ot cutting and double-staining vegetable sections, beginning by describing the proper method of honing a razor.

Slides prepared by this process, and mounted by Misses Cummings and Whipple, were exhibited. A cross section near the tip of the root of an air orchid, showing fibro-vascular bundles, and fissure-like markings on cells of epidermal tissue, also vertical section of stalk of corn showing reticulated and annular vessels in fibro-vascular bundles, were noticeable. Miss Whiting called attention to the receipt of fifty of Smith's slides of Diatomaceæ, also of the splendidly illustrated monograph of Haeckel entilted "Die Radiolarien."

After the more formal meeting the members and guests adjourned to the labratory to inspect the slides under the microscopes and converse upon the subjects of the evening.

Adjourned for two months.

MARION METCALF, Corresponding Sec'y.

Liverpool Microscopical Society.—The second ordinary meeting of this year was held at the Royal Institution, Colquitt Street, on Friday, February 7, 1879, Mr. G. F. Cantrell, Vice-President in the chair.

Mr. Isaac C. Thompson, Honorable Secretary, read a paper on "The Mounting of some Low Forms of Life," referring chiefly to the Rotiferæ. It being, he said, commonly supposed that the lower forms of aquatic life could only be studied in a living state and during the summer months, he wished to show that many interesting points of animal structure were in reality most clearly seen when mounted. To illustrate this, Mr. Thompson exhibited under a 1-12 inch objective the mastax, or muscular jaws, common to rotifers, which, though indistinct during life, possess extreme beauty, and rendered clearly visible after a careful soaking in potash solution. On the other hand, as potash destroyed more delicate organs, as for instance the celia, it was always well where feasible to mount two or more specimens on the same slide, one not having been subjected to the action of potash. This was but a single instance out of many, which showed that it was easy to furnish valuable winter study from preserved specimens of summer pond life carefully mounted. An interesting discussion on the paper followed, in which G. F. Chantrell, Rev. W. Banister, and others took part.

The meeting concluded with the usual conversazione and exhibition of microscopes.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Will exchange for well-mounted objects, human teeth sections from any part of tooth desired. H. A. Moyer, Kendallville, Ind.

Slides of pine pollen, so-called sulpher shower, which fell in eastern Pennsylvania, March 17. Diatoms, vegetable stainings, etc., in exchange. C. Henry Kain, 524 Cooper street, Camden, N. J.

Wanted, a good stage micrometer, in exchange for fine diatoms and other desirable material. M. A. Booth, Longmeadow, Mass.

Wanted, an achromatic condenser and fitting, or Wenham's parabolic reflector, in exchange for books on medicine, or state what is wanted, H. V. H., P. O. Box 47, Coeymans, Albany Co., N. Y.

Slides of Nummilitic limestone from Pyramid: foraminiferous limestone, India; deep sea dredgings, various parts; Sertularia. Histological or pathological specimens preferred. Dr. Chas. L. Swasey, New Bedford, Mass.

I have for exchange a Kinne self-centering turntable with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypens, both pure; best Jutland cement-steip, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod, and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¼ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 243, Greenport, Suffolk County, N. Y.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. IV. NEW YORK, APRIL, 1879. No. 4.

Immersion Illuminators.

BY J. MAYALL, JR., F. R. M. S.

Read before the Royal Microscopical Society, Jan. 8, 1879.

THE need of special apparatus for illuminating objects mounted in balsam, or other refractive medium, seems to have been clearly in Mr. Wenham's mind when he contributed his paper on "Illuminating Opaque Objects" to the 'Transactions' of the Society in 1856. The appliances then described were, a right-angled prism, a truncated hemispherical lens, used with his paraboloid, and the "paraboloid of solid glass with a flat top." These were, strictly speaking, immersion illuminators: the last is the original "immersion paraboloid." It was shown by diagrams that the illuminating rays were made to impinge on the upper internal surface of the cover-glass at an inclination beyond the "critical angle" (or flat-plate limit between glass and air), and reflected by total reflection upon the object, which is then seen in a dark field.

The reflex illuminator designed by the same inventor, sixteen years later, was based on the same principle.

With these appliances, used according to the principle of construction, dark ground illumination is produced with dry objectives, whether the illuminating rays are internally reflected from the cover-glass on to the balsamed object, or the object is capable of deflecting the direct rays from the illuminator, so as to become self-luminous and visible by means of what may be termed scattered rays.

It has been generally held that, as stated by Mr. Charles Brooke, "the more minute structure of some objects is cognizable only by its influence on rays traversing the object at considerable obliquity." To this end many appliances have been designed to be used with dry objectives. In Amici's prism, Nachet's prism, the truncated paraboloids, right-angled prism, truncated hemispherical lens, Reade's dark ground illumination, the "kettledrum" diatom prism, the reflex illuminator, and others too numerous to mention, we have either the use of an actual stop to block out portions of the rays, or the illuminator is placed in such a position as to provide light in particular directions. The main purpose in all is to utilize the more obliquely incident light to the exclusion of the central.

On the importance of regulating the obliquity of the illumination on the object in its relation to the apertures of dry objectives, I quote from Mr. Wenham's paper "On the Illumination of Objects . . . "*:

"Practically it is found that there is a precise but different angle of illumination required for every aperture of the object-glass, in order to give the maximum of distinctness; or that will even at all develop the markings on difficult tests. For if we continue to increase the angle of the mirror [he refers to diagram] the object first acquires a pearly appearance, and is afterwards seen in a dark field known as 'Reade's back ground [black ground?] illumination' . . . . but the markings have again become indistinct, or disappear altogether, showing that it is needful to allow a small portion of the light from the source of illumination to pass into the object-glass, and through the object, that the striæ may either be rendered more visible by the rays that they intercept, or that the field shall be partly luminous."

Within the last few years the apertures of objectives have been so considerably extended by means of the immersion system, that, in order to utilize their fullest power, it has been found necessary to use an immersion system of illumination. By these means we obtain direct rays (i. e. rays other than those merely deflected by the object) from the illuminator at greater inclination than the critical angle, which certain of these immersions will transmit, producing a luminous field.

When the object is in balsam, and the base of the slide plane and in air, no rays can reach it from beneath at an obliquity greater than the limiting angle for balsam. In order that direct rays may enter the balsam beyond the inclination of 41 degrees, we must have recourse to an immersion condenser, or something equivalent.

But it must not be supposed that the limiting angle at which rays could be admitted into balsam from beneath, through a flat plate of glass, imposes the same limit to the angle up to which an immersion objective could collect image-forming rays, supposing them to have got into the balsam,—which assumes that the image-rays above the object are limited by the angle of the direct illuminating rays from beneath. This erroneous view has had some currency, and may be thus stated: Because the object in balsam cannot receive light from beneath beyond the limiting angle for balsam, unless we have an immersion system of illumination (supposing the base of the slide plane and in air), therefore there are no rays from the object beyond that limit to be transmitted by the immersion objective, however great its aperture; the question arising—"Where can such rays come from?"

It is evident that, independently of the angular direction of the illuminating rays, if there be an object in the field capable of scattering (and not merely intercepting) light, it is seen luminous by scattered rays. Regarded then as a self-luminous object, rays are nascent therefrom and scattered equally in all directions, and therefore at greater inclination than 41 degrees. There is no theoretical difficulty in their reaching the second surface of the front lens of an immersion of suitable form, and in their being transmitted. They cannot, however, take part in the formation of the image by a dry objective, because they are internally reflected by the cover-glass. These rays must be regarded as important for delicate markings, as evidenced by comparing the definition we obtain with the highest-angled immersions and dry objectives on a balsamed object with ordinary illumination,—that is to say, when the base of the slide is plane and in air.

The utilization of the whole of the very large cone of rays that might be condensed on the object by using an immersion illuminator having an aperture equal to that of the objective, in other words, the direct illumination of the whole aperture is not the problem that has engaged the attention of those who have endeavored to exhibit the fullest power of the apertures of immersions. It was long ago found that it is not so much mere quantity of light that is required on the object, as difference of illumination that can be rendered perceptible by the eye. The more difficult images are seen only as we utilize the extreme marginal aperture of the objective, and the more oblique direction of the illuminating pencil. This can only be done practically by excluding all excess of central light. The objects on which the fullest power of the aperture is needed are generally so nearly of the same refractive index as the fluid in which they are immersed, that there is difficulty in making delicate differences of transparency perceptible. The immersion system of illumination becomes all-important to this end, as, by it, any required degree of intensity of light can be got upon the immersed object at the most favorable obliquity for the aperture of the objective.

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*"Quarterly Journal," 1854, Vol. II, p. 152.

It is found in practice that to obtain the fullest effect on the object, of the extra-oblique rays provided by immersion illumination, the objective must have an aperture capable of transmitting them, so that the field is luminous; they thus become a practical proof of the extent of the aperture. It follows also, as matter of observation, that up to the angle to which the objective refracts the direct rays from the illuminator to a luminous field, to that angle (or very nearly so) it refracts image-rays from the object; for we find that increasing the obliquity of the direct illuminating rays so as to approach to the dark-field, produces, at the same time, distortion of the image,—showing that both systems of rays traverse the objective together.

The angle of the direct illuminating rays must not, however, be regarded as an essential condition of the existence of the aperture (as such). It proves the extent of the aperture of the objective by direct transmission; its effect in rendering visible minute structure is plainly matter of experience,—and experience shows that, so far as apertures have been carried, the gain has been in proportion to their capacity for direct transmission.

It will be understood that I refer only to objectives in which the corrections have been made to the fullest extent of the aperture; for it must be agreed that there is no such thing as aperture, properly speaking, unless the image of a point be rendered as, approximately at least, a point.

Now, although, as I have shown above, Mr. Wenham understood the need of special means for illuminating obliquely objects in balsam, and the importance of the angle of illumination in relation to the aperture of the dry objective, I do not think he can be credited with having understood (much less foreseen) the important part the immersion illumination of balsamed objects would take in the development of the fullest power of immersion apertures. Indeed, as he has contended that the 82 degrees limit of dry objectives obtains equally in immersions, he must be held to deny the existence of any aperture beyond 82 degrees: consequently, the application of the immersion illuminators above mentioned, for directly utilizing any such aperture, must be regarded as a discovery quite apart from his original application of them for dark-ground illumination.

It appears to me that to Mr. Tolles is due the merit of first applying immersion illuminators to balsamed objects in connection with immersion objectives for the distinct purpose of utilizing by direct transmission the excess of "interior angle" beyond 82 degrees. He was the first to produce objectives having interior angle considerably beyond 82 degrees, and to demonstrate their advantages. With these objectives a luminous field was obtained when the whole of the illuminating rays that can enter into a dry objective were blocked out, and none but rays beyond this limit admitted: thus exhibiting at once a luminous field and a definition of immersed objects by means of the extra aperture that had not been seen before. He appears to have experimented chiefly with the semicylinder, because of the facility it offered for immediately obtaining a reading of the precise degree of inclination the illuminating rays made with the axis, so as to determine the actual limit of the apertures of the objectives he had devised; the display of difficult test-objects being merely incidental to his efforts to improve the instrument.

Dr. Woodward has given special prominence to the principle of the immersion illumination, in its immediate connection with the development of the power of aperture, by his "simple device," in which he originally provided means to exclude all rays of less inclination in glass than 45 degrees from the axis, so that no objective having "interior angle" less than 90 degrees would give a luminous field with it: it thus affords a proof of his position in the aperture question. Viewing it as an illuminator only, Dr. Woodward has simplified the mode of mounting the prism, and slightly varied the angle in a second prism: his last paper referred to these changes. I was also led to design a modification of this device, which is, briefly, to utilize the four exposed surfaces of the prism by cutting them at different angles, so as to approximate nearly to the semi-aperture of the objectives likely to be used. This purpose is attained with a success approaching perfection in Tolles' "traverse-lens," which I hope to place before you shortly, with the inventor's notes.

Many experimental devices have been made for the same purpose. At the last meeting I exhibited another modification I had had made of Dr. Woodward's "simple device;" also a nearly hemispherical lens, and a small semi-cylinder, conveniently adapted for use on the substage.

I mention Hyde's oblique illuminator for its novelty in combining a condenser with prism-illumination. It is a right-angled prism with a lens of short focus cemented on the long face, and will give a beam of condensed light up to a high degree of obliquity. Captain Tupman brought it from America four years ago. I am not aware whether the inventor designed this for the purpose of utilizing by direct transmission the extra-oblique rays that can be utilized only by immersions having "interior angle" beyond 82 degrees, or he intended such rays to produce dark-ground illumination only. The plan is ingenious. I have, however, found, by cementing a small lens on one of the exposed faces of Dr. Woodward's prism, the same results are obtained more conveniently.

I refer also to a plan of illumination which Captain Tupman informs me is due to Mr. Tolles. It consists of placing a suitable prism in immersion-contact on the surface of the balsamed slide, so that rays from a bulls-eye lens may pass directly to the internal surface of the base of the slide at an inclination beyond the critical angle, they are then totally reflected to the object. This requires some care in the manipulation.

Professor Abbe has adopted the use of a small lens* placed in immersion-contact with the base of the slide; which is a very simple and effective plan, and has been known for some years past. It is really so practical as almost to supersede the more elaborate contrivances for use beneath the stage.

Lastly, I refer to a reflecting immersion illuminator, which I have suggested to Professor Abbe, and which he has undertaken to have made for me by Mr. Zeiss: this will be placed before you when completed.

Immersion illuminators are designed to secure a particular angular direction to the illuminating rays while actually in the body of the fluid in which the object is immersed, with a view to utilizing incident light of great obliquity; used in connection with the highest-angled immersion objectives, they have given fair grounds to expect that the future of the most difficult investigations in microscopy will be largely dependent on their successful application.—*Transac. Royal Microscopical Society.*

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— The British Royal Geographical Society is urging the establishment of Chairs of Geography at Oxford and Cambridge.

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*At the meeting in June I erroneously stated that Mr. Wenham had used a similar lens for the same purpose many years ago. He used the lens for reflex illumination from the cover-glass—*not* for direct illumination.

Spider's Web for Micrometers.

THE web used is that of the common garden spider; the spinner of those geometric webs is abundant in summer and autumn. The reason why this spider is selected, rather than the house spider, may easily be seen by anybody who watches the proceedings of each when a fly is caught. The house spider seizes his victim and spins around him a winding-sheet of web, before carrying him into the larder. The garder spider binds around his captive a cord of web. It is this cord that is used for collimation.

In the autumn the mathematical in-instrument maker goes on his spider-hunting expeditions, generally on Sundays. He carries some pill-boxes in his pocket; selects well-fed, full-grown specimens, and puts each in a separate box, knowing the savage habits of his eight-legged friends; for if two or more were put together in the same box, only a collection of amputated limbs and mangled bodies would be found on returning home.

The webs are secured for use and storage by making a fork of iron wire, four or five inches long, and one and one-half to two inches between the bifurcations. The spider is held in the left hand and allowed to drop, which he readily does when dissatisfied with his quarters, but before dropping he glues an end of cord to the finger, and then lets himself down easily by gradually spinning it out and hanging by it as it lengthens.

The instrument maker catches this cord across his fork, and, by turning, attaches it to one side; then he goes on turning the fork and advancing it, so that as the spider continues paying out his cable a series of obliquely crossing threads are wound upon the fork, which when charged, is carefully laid in a box or drawer for use. The elasticity of the iron wire keeps the webs sufficiently stretched, and they are applied to the stop by simply laying the fork over it in such wise that one of the stretched webs shall fall upon the mark made on its face. When thus in position, a drop of varnish or glue, made by dissolving shellac in alcohol, is let fall upon each side; the spirit rapidly evaporates, and the web is fixed.

One of the odd results of this use of spiders is that many workmen become spider fanciers, and keep choice domesticated specimens that learn to spin their webs in convenient places above the work-benches, or in the bedrooms of their masters, who lovingly supply them with the fattest of blue bottles. Though I forsook the trade on the expiration of my apprenticeship, I have not yet lost my affection for these animals—I never wilfully kill a spider. A sad story is told of the desolation of the late Mr. Troughton, who on one ocsasion engaged a new housemaid, and allowed her to commence professional operations without receiving the usual injunctions concerning his pets.—*W. Mattieu Williams, in Journal of the Society of Arts.*

On the Present Condition of Microscopy in England.

BY FRANK CRISP, LL.B., B.A., SEC. R. M. S.

Read before the Royal Microscopical Society, April 3, 1878.

MY object this evening (writing throughout in the spirit of the Publican and not of the Pharisee) is to call attention to what I think is an indisputable fact, that in recent years no substantial progress has been made in this country either in the knowledge of the theoretical principles of the microscope itself, or in the systematic investigation of microscopical phenomena.

The microscope has, in fact, come to be regarded merely as the tool of the naturalist and the histologist; and notwithstanding the objects for which this society was established,* it may, I think,

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*The statement of the "Objects of the Society," prefixed to the Charter and By-laws, sets forth that "the Society was established *for the promotion and diffusion of improvements in the optical and mechanical construction, and in the mode of application, of the microscope*:—

"*For the communication and discussion of observations and discoveries tending to such improvements or relating to subjects of microscopical observation*:—

"For the exhibition of new or interesting microscopical objects and preparations, and for be truly said that out of the entire scientific world there is probably no body of men who devote so little real attention to the principles that lie at the root of that branch of science of which they are disciples, as do the English microscopists.

As a particular instance, I may refer to the apathy that has been shown in regard to the researches of Professor Abbe on the theory of the microscope,—researches undoubtedly as important as any that can be found in the whole of its history, and rivalling even the discovery of achromatism, or that of Lister on aplanatic foci. It is, I think, not a little humiliating that such a discovery—in one aspect so simple—should not have originated in this country, we being the first, and for many years the only, nation to maintian a "Microscopical" Society.

Whatever may be the cause of such apathy, it is evident that it cannot be attributed to any deficiency in the power of perseverance; for when we enter upon the discussion of a question, say of angular aperture, we do not rest content until a point has been reached which renders it impossible for anyone to say that the subject has not been exhausted to the very last limits.

For this the condition of our literature is in part answerable. Recall the contents of the generality of modern English treatises on the microscope, and what do we find? Out of a given number of pages, a very small portion only is devoted to the optical principles of the microscope and to microscopical phenomena (about as much as is to be found prefaced to foreign books on histology or botany that do not pretend to be treatises "on the microscope" at all), and what is given is in the most elementary form that can be conceived. The remainder of the book is avowedly a condensed summary of the whole range of subjects belonging to natural history—a small natural history cyclopaedia.*

If we compare our books with those of some other countries, in particular Germany and Holland, the conviction must be forced upon us that we in England have not in modern times kept pace with the progress that has been made elsewhere. I am not venturing to reflect in any way upon our authors, the blame must rest upon ourselves and not upon them. The supply is necessarily regulated by the demand—if there is no demand there can hardly be expected to be any supply, so that any improvement must originate from ourselves.

The principal reasons, as I conceive, for this state of things are these:

In the first place, a feeling has gained ground amongst us that the only proper field for the microscopist is to be found in the investigation of one or other of the many branches of natural science that require the aid of the microscope, and hence the theory of the microscope itself and of microscopical phenomena is regarded as altogether puerile and unworthy of the attention of the true microscopist.

For myself, I may freely confess that (erring, no doubt, in the opposite extreme) I take a comparatively small interest in the subjects to which the microscope is applied, and that I am almost inclined to look on the term "microscopist" as not being properly applicable to those who are engaged in the study of natural history, even although it may be essentially by means of the microscope—in fact, that as it has been said "the proper study of mankind is man," so the proper study of the microscopist is the microscope.

It has been objected, and no doubt will be objected again, to this view, that it is fallacious, in so far as it exalts to an end that which ought only to be looked upon as the means to the end—that the microscope (as I was recently told) can be properly regarded as nothing more than the ladder by which we climb to a

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the formation of an arranged collection of such objects :—

"*For affording the opportunity and means of submitting difficult and obscure microscopical phenomena to the test of instruments of different powers and constructions* :—

"For the establishment of a library of standard microscopical works."

*This does not, of course, apply to books that do not pretend to describe the microscope, but to furnish directions for its use.

point from which a better prospect may be obtained, and that it is a waste of time in such a case to devote attention to the ladder rather than to the prospect.

Such an argument—one that exalts the applications of a science at the expense of the investigation of its theoretical principles, on the ground of the greater practical value of the one over the other—is a strange one to be used by scientific men. It is the merest truism to say that the only sure way to advance any branch of knowledge is by undertaking a complete and exhaustive investigation of the theoretical principles on which it is based. All the practical inventions ever made have depended for their discovery on the previous investigation of mere theories, by men who pursued knowledge for its own sake alone, and without stimulus from any notions of practical utility.

As an old writer (Malthus) has put it:—"It surely would be most unwise to restrain inquiry conducted on just principles, even where the immediate practical utility of it is not visible. In every branch of natural philosophy how many are the inquiries necessary for their improvement and completion which, taken separately, do not appear to lead to any specifically advantageous purpose; how many useful inventions and how much valuable and improving knowledge would have been lost if a rational curiosity and a mere love of information had not generally been allowed to be a sufficient motive for the search after truth."*

If only the lowest view of the microscope is to be accepted, the improvement of the mere tool must necessarily have an important influence on the perfection of the work performed by its aid, so that the improvement of the microscope will directly further the aims of the naturalist.

Another reason which has also operated to produce the present condition of things is, that some kind of belief, more or less definite, has grown up, that we have arrived substantially at a state of perfection, or at the limits of the possible; that there being no further scope for improvement, the study of theoretical principles has become a matter entirely of antiquarian research.

I should not have thought that such a belief could be seriously held, had it not received the sanction of one of our high living authorities, who, whilst sufficiently cautious to guard himself against being supposed to assert the absolute impossibility of further improvement, yet, after speaking of the microscope as having "acquired the deserved reputation of being one of the most perfect instruments ever devised by art for the investigation of nature," ventures to say that "the statements of theorists as to what *may* be accomplished are so nearly equalled by what *has* been effected, that little room for improvement can be considered to remain until chemists furnish opticians with new varieties of glass whose refractive and dispersive powers shall be better suited to their requirements."*

This statement depends for its validity upon the assumption that the theorists have themselves arrived at the stage of perfection, an assumption which has no real foundation. I venture to think that there are few persons in the present day who would be found bold enough to assert that we have arrived at perfection in any branch of science, least of all in that of microscopy. Adopting the view of Sir John Herschel, "we are not to suppose that the field is in the slightest degree narrowed, or the chances in favor of fortunate discoveries at all decreased, by those which have already taken place; on the contrary, they have been incalculably extended. It is true that the ordinary phenomena which pass before our eyes have been minutely examined, and those more striking and obvious principles which occur to superficial observation have been noticed and embodied in our systems of science; but not to mention that by far the greater part of natural phenomena remains yet unexplained, every new discovery in science brings into view whole classes of facts which would never otherwise have fallen under our notice at all, and establishes relations which afford to the philosophic mind a constantly extending field of speculation, in ranging over which it is next to impossible that he should not encounter new and unexpected results. . . . In whatever state of knowledge we may conceive man to be placed, his progress toward a yet higher state need never fear a check, but must continue until the last existence of society.'*

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* 'Principles of Political Economy.' This point has also been well treated by Professor Tyndall in his concluding lecture on Light.

*Carpenter, 5th ed., 1875, p. 6.

If perfection is ever to be assumed, one might fairly have assumed that the vast amount of research which has been bestowed upon the subject of electricity, the many minds that have for many years been engaged upon it, and the stimulus of the brilliant pecuniary and other rewards which have been earned, would have brought that branch of science, at any rate, to perfection; and yet it is only to-day that the telephone has been discovered—an invention, not the least remarkable feature of which is its extreme simplicity.

Even, therefore, if the theoretical principles of microscopy had been apparently as well investigated and as well exhausted, we should still not be justified in "resting and being thankful;" but when, in fact, no such equivalent work has been done, I cannot be accused of any tendency to be over-sanguine if I think that the period of perfection in regard to the microscope is certainly yet before us.

The microscope, beyond all other instruments, has already suffered greatly from the belief that it could not be improved. So splendid a discoverer as Newton asserted that achromatism was "impossible," though the fact of the achromatism of the eye was as ready to his hand as it was to that of Hall; and even after achromatism had been established, Biot (no mean authority) declared that it would be "impossible" to work achromatic object-glasses for the microscope on account of their diminutive size.

It is both amusing and instructive to take books written at different periods of the present century, and note how each writer in his turn expresses the conviction that now at last perfection has been reached. Thus Sir D. Brewster, in 1813, wrote that, "in the combination of single lenses to form the compound microscope, opticians have arrived at a great degree of perfection." In 1829, after the first achromatic object-glass had been successfully made, Dr. Goring wrote that "microscopes are now placed completely on a level with telescopes, and like them must remain stationary in their construction." Sir D. Brewster, later, wrote: "The ingenuity of philosophers and of artists has been nearly exhausted in devising the best forms of object-glasses and eye-glasses for the compound microscope." What was written so lately as 1875 I have already referred to.

I believe that we are far from having arrived at the limits of the possible; but whether this view is accepted or not, I may, I think, assume that, however high may be the authority on which such a statement as that which I have referred to is made, there can be no necessity to spend any time in proving that much is still to be learnt—that we all agree in the definition given of the character of the true philosopher, "hoping all things not impossible, and believing all things not unreasonable," and "are ready to encourage rather than to suppress anything that can offer a prospect or a hope beyond the present obscure and unsatisfactory state."

What, in my view, is desirable, is not that the society should value less highly than they do now investigations in the various branches of natural science that can be made only by the aid of the microscope, nor that we should in the smallest degree diminish the appreciation which we have of those Fellows who bring the results of such investigations before us; but simply that *more* attention and encouragement than are given at present should be given by the society collectively, and by the Fellows individually, to what I may call the subject of pure microscopy, which may be considered as standing in much the same relation to what is now accepted as "microscopy," as pure mathematics stands to applied mathematics (so called).

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*'Discourse on the Study of Natural Philosophy.'

The optical principles of the microscope and its accessories form one branch, the other deals with the investigation (considered mainly as a problem of mathematics and physics) of the phenomena presented by objects viewed by means of the microscope, and the determination of their real properties, notwithstanding their deceptive visual appearances.

It would perhaps be only imitating the old quarrel of the logicians to discuss whether there can be any science of microscopy outside these limits; but if it be otherwise, the boundaries of the science must be as extensive as the world itself, the elephants and palms having as good a claim in that case to be considered "microscopic objects" as the rotifers and the diatoms.

I need not dwell on the first branch further than to point out that our textbooks give the uninstructed reader the impression that the microscope stands in point of principle on no higher level than the telescope. This is far too low an estimate, and it would be truer to say that the microscope stands to the telescope at as great a relative distance as the chronometer stands to the sun-dial. Without having before them the means of comparison, it will, I know, be difficult, if not impossible, to convince the Fellows how much there is in this respect of which we know absolutely nothing: when the comparison has been made, the absurdity of the chapter in our books which professes to deal with "the optical principles of the microscope" will be fully appreciated. Whilst as M. Robin, the French histologist and microscopist, says, "it is absolutely necessary to be familiar with all that concerns dioptrics when one has to make use of an instrument whose invention has been inspired by the discoveries made in this part of physics," I do not know a book that even attempts to instruct the microscopist as to the course of the rays in passing through the ordinary objective of a compound microscope, or ventures upon anything beyond the barest mention of diffraction—the most common of all microscopical phenomena, and most intimately concerning not only the theory but the practical working of the microscope.

At the present time there is nothing extant which constitutes even a commencement of a systematic theoretical treatment of the subject of illumination, yet, being purely optical, it is obviously capable of being so treated, and great practical advantages would undoubtedly follow from the development of an exact theory on the subject. In nothing has the ingenuity of microscopists been more exercised than in the invention of novel modes of illumination for lined objects; but however clearly these various appliances may bring out particular appearances, there is good reason to believe that in the majority of cases they are illusions, originating in the character of the illumination employed, and that all possible methods of illumination may be reduced from the fifty or more kinds now existing to less than half a dozen at the most.

With regard to the second branch, the conditions under which microscopic vision takes place necessitate (at any rate, in our present stage of experience) a more or less laborious reasoning process before we can recognize what it is we really see, though long experience and habit have enabled us (apparently) to dispense with any such reasoning in the case of ordinary vision. The appreciation of this necessity has, in modern times, been a little lost sight of, and there has been too great a tendency to depend on mere sense, instead of on sense and reason combined, or, in other words, to merely view the object, rather than to investigate its true nature. "The impressions of sense," says Whewell, "unconnected by some rational and speculative principle, can only end in a practical acquaintance with individual objects."

For this reasoning process, data are in the first instance required. These data, obtained from a systematic and scientific investigation and recording of the varied experience of microscopic vision, considered, so to say, in the abstract, are of the highest importance, and would, in time, serve to render microscopic observation almost wholly free from the fallacies and uncertainty which now beset it.

Although it is a stereotyped expression of our authors that in the case of the microscope "seeing is not believing," the subject is left with the vague warning, that "no rules can be given for the avoidance of such errors, since they can only be escaped by the discriminative power which education and habit confer." *

I venture to think, however, that there can be no difficulty in framing such rules. It is only necessary that microscopists who have acquired the power referred to should record the results of their discrimination and experience.

If each observer keeps the results of his observations for his own exclusive use, little or no advance will, of course, be possible; but progress will be greatly accelerated if such records are made, for new workers are able to take up their investigations where their predecessors left off, and not only avoid the waste of time and misdirection of energy involved in going again over ground already exhausted, but also the discouragement which necessarily arises from the uncertainty whether what they propose to do has not been done before. One of the most useful offices of such a Society as ours is the assistance it is able to give to this object, so that it is not necessary that any one should write a complete treatise on the subject, but by means of our "Proceedings," can note isolated facts for the use of future students.

The phenomena to be investigated range over a very wide field, and it is not possible, within the limits of this paper to present a complete analysis of the subjects in regard to which systematic investigation would be valuable.

Among them would be the appearances presented in consequence of the refraction of light by objects of various regular or irregular forms, spherical or cylindrical, with waved or other surfaces, hollow or solid, and of different densities. The effects produced by the reflection of light from objects in numerous modes. The varied and deceptive appearances brought about by the interference of light, a subject which in England, at any rate, is in its relation to the microscope almost untouched. The effects produced by double refraction and polarization. The variations, in differing circumstances, in the colors of bodies. The large range of phenomena involved in the appearances presented by the same object with different kinds of illumination, or in media of different refractive powers. The determination of the indices of refraction and dispersive powers of objects (matters which materially aid in the determination of their true nature.) The discrimination of holes from mere depressions, and other variations of structure.

A few clearly settled generalizations would enable a large group of phenomena to be resolved.

As an example of the way in which what is only one small item of this subject may be treated, I may refer to the discussion by Nageli and Schwendener of the interpretation of the image of a hollow cylinder, a typical form of microscopic object.

They discuss the theory of the formation of the image in four groups:

1st. The peripheral rays which traverse the walls of the cylinder without entering the cavity.

2d. The peripheral rays which strike the internal surface of the cylinder very obliquely, and are there reflected.

3d. The rays which penetrate into the cavity of the cylinder and are reflected on the walls, then arriving at the objective after having undergone two refractions (that is in all, four refractions and one reflection).

4th. The rays which traverse the cavity of the cylinder in a straight line and undergo a quadruple refraction.

Thus is shown on theoretical principles the appearances which such objects will present in different media, or in the

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*Carpenter, 5th ed., p. 195.

other varying conditions in which they may be placed.

I have disclaimed the necessity of having to prove the practical use of such investigations; but "without prejudice" (as the lawyers put it) to that position, I may ask if it can be doubted that such generalizations would be of the greatest assistance to other observers, and the practical results important and useful?

There are numerous instances of the way in which the appreciation of purely optical or physical principles has served in the past to elucidate biological questions, and may serve to elucidate others in the future. I remember having read (though I have been unable to verify the passage) that Harvey himself attributed his discovery of the circulation of the blood to the investigations he had previously made on the pressure of liquids in tubes.

So simple a matter as the experiences of Welcker on the effects produced by globules of air or oil immersed in a fluid of greater or less refractive power than themselves, has enabled subsequent observers to distinguish more readily, and with more accuracy elevations from depressions, and to determine the true structure of a large class of objects, so that vacuoles need no longer be mistaken for nuclei.

The supposed tubular structure of human hair can be shown to be erroneous by the application of such principles, and the belief in the solidity of the lacunæ of bone was disposed of by a consideration of the refractive effects of Canada balsam.

The determination of the refractive index of a substance will often show that it belongs to one class of bodies, such as the albumenoid, and not to another, and enables proper deductions to be drawn of the real as opposed to the apparent size of cavities, such as those in the interior of starch grains. If an object exhibits double refraction it cannot be fluid, and the examination of muscular fibre by polarized light will determine whether it is at rest or in the state of contraction.

A paper by Mr. Lowne, just read before the Royal Society, on the "Eyes of Insects," will furnish another instance of the assistance the naturalist would derive from being able to refer to an established theory of microscopical observation, an important part of the conclusions come to in the paper turning upon the results of experiments on the effects manifested by the transmission of light longitudinally through glass tubes and threads.[*]

Our friends the histologists have arrived, as some of them conceive, at the limit of the resolution of structure; and my senior colleague, who is ready to seize with such avidity on any process that seems to indicate the possibility of further knowledge on histological subjects, would, I am sure, rejoice if he could be guaranteed the power of determining more of the ultimate structure, say of a muscular fibre, than he is now able to do.

I believe that guarantee might be given if the work I am advocating were undertaken, and that it would be found in the result that the histologist best grounded in such work was the best authority in the determination of structure,[†] and many at present obscure problems would be in a fair way of solution.

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[*] Since printed in 'Proc. Roy. Soc.,' vol. xxvii. 261.

[†] Since this paper was written, I have seen the lecture on "Microscopes" (in Vol. I of the 'Science Lectures at South Kensington'), by Mr. Sorby, F. R. S., the late President of this society, in which he points out (p. 203) that "much may be learnt by the study of mineral structures, since in the case of crystals and of solid portions of glass and other analogous objects we know what their character is, whereas in the case of minute organic structures we have rather to infer what is their structure from what we see; therefore, in forming some general idea of illumination, I think we may learn a great deal by studying what we see in small crystals and in inorganic bodies of pretty well known form." And again (p. 207), dealing with the effect of a particular kind of illumination on mineral structures, he says that it "would be equally applicable in the case of rods and minute fibres, and such kinds of structures as are commonly met with in organic bodies." And (p. 209). "Such general conclusions are more simple and obvious in the case of mineral structures, but are by no means confined to them, ... and I cannot but think that much remains to be learned even in the case of more purely organic structures."

It would be no less a "practical" benefit if we were able in future to avoid some of the mistakes of recent years. Amongst these may be mentioned the views held up to the present day, that the resolution of lined objects depends upon the shadow cast in consequence of the obliquity of the light. Mr. Stephenson has reminded me of the derision (in which I joined) with which the object-glass of Mr. Tolles, with its marked aperture of 180 degrees, was received; and yet at that time the demonstration existed that the effective angular aperture of an object-glass may readily exceed 180 degrees.

Another instance may be found in that vexed question of a few years since, the Aplanatic searcher. At the time it did not seem to me unreasonable in theory that the defects of an object-glass might within limits be neutralized in the way proposed. The practical reason for not accepting the invention was the absence of results in the hands of any one but its inventor; but no one was able to expound the principles, then well known elsewhere, which showed that its theory was unsound. If we had been aware of those principles we should have been able to discuss the claims of the invention in an intelligent manner and without having to depend solely on the want of results.

What seems to me to make the subject the more tempting is, that it is virgin soil; any of us who will take it up will not find it has been occupied before him, and the society in receiving the results will not be in close competition as they are now with other societies,—in fact, we should then be working in a field of our own, the want of which has been so often bewailed among us.

The examination of diatom valves and Podura scales has undoubtedly been the cause of many improvements in object-glasses, and the indiscriminate abuse sometimes showered upon the observers is to a great extent undeserved: at the same time it is certain that there has been much misdirection of time and energy in such examinations, so far as the end proposed has been only to see with one glass for the hundredth time as nearly as possible what has been seen a hundred times before by a hundred other observers. Such examinations, if properly directed, would have advanced the knowledge of microscopical phenomena in general many years

Of the two great methods of scientific inquiry, observation and experiment (or as they have been otherwise termed, "passive and active observation"), we have, I think, confined ourselves too much to the first, to the disregard of the second. So long ago as the time of Fontana, he wrote, "It is easy to view the image which is offered to the eye, but not so easy to form a judgment of the things that are seen, as an extensive knowledge of the subject, great patience, and many experiments will be found necessary for this purpose, for there are many circumstances where the images seen may be very similar, though originating from substances totally different, and it is here the penetration of the observer will be exercised to discover the difference and avoid the error."

To quote Sir John Herschel once more: "It has been found invariably that in those departments of physics where the phenomena are beyond our control, or into which experimental inquiry from other causes has not been carried, the progress of knowledge has been slow, uncertain, and irregular; while in such as admit of experiment, and in which mankind have agreed to its adoption, it has been rapid, sure and steady."*

In microscopy experiment is, of course, more difficult of application than it is in some other branches of science, but there is still ample room for it; many instances will readily occur to you, such as those of the late Mr. Richard Beck on the Lepisma scales, Mr. Slack's silica films, and others, which have now and then appeared in our "Proceedings."

It may be that the work I suggest has already been in great part done; if so, it has not been recorded, and for all useful purposes might as well not have been done. It may also be that it is not so inexhaustible as I suppose; in that case there is the less reason for not exhausting it. Whilst I do not hold the view which some people in this country are fond of pretending to hold, that nothing valuable is to be found at home, and that everything abroad is necessarily of superior merit, we may at least set before us, as a goal worthy of being reached, the attainment of a position in our own particular branch of science on a level (to say the least) with that of other countries.

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* "Discourse on the Study of Natural Philosophy."

I know that those amongst you who hold my views are comparatively few in number. I have, however, put them forward now, so that what it is we advocate may be understood, and others may possibly thereby be converted to the true faith. However erroneous or fanatical those views may be considered, I cannot think that any harm can result from thus stating them.

To the retort, "Physician, heal thyself," I can only say that it is a matter of no small regret to me, that with every inclination to lead the way, an insuperable barrier should be presented by the exigencies of my particular avocation, which not only reduce to small proportions my leisure hours, but render it necessary that those hours should be mainly employed in a recuperative process; one evidence, however, that I can give of my sincerity is, to undertake a matter which I believe the society would be doing good service to microscopy if it undertook itself, but which it can hardly be expected to undertake if it does not believe in its necessity, and that is to enable English microscopists to read in their own language one of the best modern German treatises—one which (as a deceased colleague on the Council of this society declared) is "a mine whose treasures might occupy many workers in developing."

Whilst it does not pretend to be exhaustive, it will at least serve (to put it no higher) to show how extensive a field a complete knowledge of the subject embraces, and until we are able to improve upon it, it will, I think, worthily supply the want which just twenty years since was referred to in an article in the *Quarterly Journal of Microscopical Science*:*—"The period has not yet arrived when all those who employ the microscope methodically as a means of scientific investigation possess an intelligent comprehension of the principles on which it is constructed, and the nature of its powers as an optical instrument. There is a large region beyond mere manipulation into which few apparently care to enter. The writers of our introductory treatises leave the matter pretty much as they found it. Surely the time has arrived which calls for more than this; when an optical treatise on the microscope, worthy of the name, is not only desired by the few but required for the many."

When completed, the society will be better able to judge whether I have exaggerated in what I have written. I have a strong conviction that the conclusion will be that I have not, and I have a strong hope that in the result a new departure will be made in "microscopy" in England.—*Trans. Royal Microscopical Society.*

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Professor Huxley on the Lowest Forms of Life.

AT a recent meeting of the Literary and Philosophical Society of Lincoln, Prof. Huxley delivered a lecture on the lowest forms of life, of which the following is an abstract:—In introducing his subject the lecturer said it was one, many parts of which were exceedingly remote from ordinary apprehension, and it therefore became necessary that he should, as far as possible, lead them to the consideration of it by beginning with something which was nearer to them, and something which they could, if they were so minded, study for themselves, and judge whether the statements he had to make to them were correct or otherwise. He had to address them about the simplest and lowest forms of life, and it so happened that there were some exceedingly familiar bodies indeed which would serve them very well as an exemplification of those lowest forms, and from which they might start and gradually work their way to those which were remote from ordinary knowledge. They were all doubtless familiar with what were commonly known as moulds—those troublesome bodies, very often of a bluish or blackish color, which invaded the pantries of even the best housewives, and covered all sorts of clothing, more especially boots and shoes. The particular kind of mould he wished to speak about was not, however, that with which they would be most familiar; it was another kind of mould which was distinguished by having a whitish color speckled over with minute dark points, and which was known as mucor; and it was with some brief statement of the results of a careful study of this mucor that he would commence his remarks upon the structure and the aims of the lowest and simplest forms of life. They found a series of threads standing up from the surface of the mould, each one of which was terminated by a globular head, as a pin might stand up from a pincushion. The bottom part ramified in the material from which the mould was growing, and branched out into a number of fine stems. If they supposed a pin in a cushion, ending where the point should be in a series of branches, that would give them a clear notion of one of these fungi to which the *Mucor mucedo* belonged. The whole of this body was made up of a sheath of the same sort of material as that which constituted ordinary wood. The case was filled with a gelatinous substance, the technical name of which was protoplasm. The protoplasm contained in the pin's head portion of the mucor was broken up into a great number of portions, so that the whole body was a kind of case filled with an immense number of minute particles. Each of these bodies had a diameter of about the 3,000th part of an inch, and in the larger heads there would, perhaps, be a thousand or two. Supposing that the plant had attained its full development, the wall of the case became extremely brittle, and the slightest touch broke it, when the contents separated from one another, and were carried about by the smallest gust of air, and each particle contained the power of growing into a plant like that from which it started. This little part of protoplasmic matter contained within itself the power, under certain conditions, of going through complicated changes, which would result in its conversion into such a plant as that from which it started; and he would ask them to attend to the precise nature of those conditions, because unless they did that they would not understand the part these low organisms played in the economy of nature. Suppose they obtained a little tartrate of ammonia, placed it in a vessel of water, dissolved it, and added to it a little of those phosphates used for manures, they would have a pure mineral water, which contained within itself not any one of the chemical compounds that were found in the organisms which he had just described. That was, however, competent to act as the soil in which the mucor would flourish and grow. Now, suppose they took one of these very minute parts of protoplasm and placed it in this water. If the weather happened to be pretty warm, what happened was most extraordinary. It threw out a prolongation on one side, and by-and-by began to throw off one on the other side, and afterward one in another direction, until at length they had a beautiful star which might be a million times greater than the spore from which it started. Yet this star contained exactly the same nitrogenous composition as the spore itself. Supposing they submitted the water and solution to chemical analysis, they would find that a quantity of tartrate of ammonia had disappeared, and that this was exactly counterbalanced by the weight of the fungi which had grown. The marvellous structures which they found took the materials supplied to them, and built them up afresh, until they converted them into substances similar to those of which the largest trees were formed. The whole of the operations went on in the dark just as well as in the light, and they appeared to be entirely dependent upon conditions of temperature. Having assumed the form of a star, by-and-by it ceased growing, but sent up a vertical stem which swelled out to a head, the protoplasm in which split up into minute particles, each of which was surrounded with a thin covering. Each of these plants did not take more than eighteen hours to pass through the whole of this process. These minute spores were carried about by the wind until, in a very short time, incalculable millions were spread about. If they grew such a body as this in a bottle, in a similar solution to that which he had described, with a little sugar, the mould came to the top; but if they shook the bottle occasionally, the filaments which made up the star broke up into rounded portions, which gave off buds. By this means they might cause the mucor to assume the form of yeast or barm, and give rise to fermentation. This was a sort of by-product of the plant that gave rise to it. Another process of multiplication was this—when the supply of nutriment became scarce, one of the stems of the stars grew toward another, and the protoplasmic matter became mixed into one common mass, surrounded with a thick coating, and a process of conjugation took place. The whole of this organism started from a minute speck, in which they could see nothing; but the spore which possessed the power of germinating went through a cycle of definite changes, and it possessed the power of manufacturing salts into a living body. In addition to this constructive power, it also possessed a destructive power, as, under certain circumstances, the yeast form broke up the substance in contact with it. Prof. Huxley then spoke of the diatoms. He said in any green pool, if they examined the sediment, they would be perfectly certain to find it full of one kind or other of these simple organisms, like a pill-box in shape. The substance of the wall answered to the cell wall of the fungi, and inside it was protoplasmic matter, and in that again there was a mucus. It also underwent a process of conjugation. The fungi must have either animal or vegetable substance to live upon; but a diatom needed nothing but carbonic acid gas, and water, nitrate of ammonia, and some phosphate, and out of these rough materials it had the power of constructing its own body. He then went on to speak of the heteromita, and in regard to monads said by fission the body was split down the middle, and afterward produced two monads where there was formerly only one. This process went on with such extreme rapidity that it was completed in four or five hours, and under favorable conditions it was perfectly possible that one of these monads might in a few days produce many successors. Speaking of the protogenes, he described them as being merely a structureless protoplasm. They were microscopically structureless, but had the power of moving, feeding, and digesting. These different bodies, minute as they appeared to be, were probably the most important members of the animal and vegetable world. The organisms they had been referring to played a more important part in the economy of nature than all the rest of the animal and vegetable kingdom put together. The fungi were the greatest destroyers of useless matter. Nature did her best to get rid of this matter. Death was said to be one of the causes of putrefaction, but this was not quite true, and it would be more correct to say that life was the cause of putrefaction. If they took proper precautions to keep away from any dead body the organisms he had mentioned it would not putrefy, and the sole cause of that most disagreeable change called putrefaction was the introduction of a particular form of life more analogous to the fungi than anything else, known as Bacteria. It was only lately that they had known much about them. The *Bacterium termo* was not more than a 30,000th part of an inch. If they took a small portion of fluid of putrefying matter they would find millions of them in every drop, darting about as if they were fishes. They multiplied with enormous rapidity, and after a certain period of activity passed into a period of rest, and afterward the protoplasmic substance broke up, and each spore gave rise to a *Bacillus subtilis* again. Their rate of multiplication was so excessively rapid that it needed only one of these Bacilli to get into a liquid, and in the course of a couple of days the whole of that liquid would be visibly turbid in consequence of the multiplicity of the bacteria to an extent which no arithmetic could express. The importance of these bodies was that they exerted a fermentative influence, and they did for the fluid what yeast and barm did. It was this fermentative product which gave rise to putrefaction, and if they took such precautions as would keep out the bacteria a dead body would remain intact for an indefinite period. It was on this principle that meats were preserved for an indefinite period by being partly boiled and then hermetically sealed in tins so as to preclude the air getting in. If they considered what would happen if all the animals that died remained where they died until they dried up, they would see what an important part these bacteria played, and if they could all be gathered together they would make more than all the rest of the animal and vegetable kingdom. But they had a great significance which it was important they should all understand. In France there was an enormous silk industry, but it sometimes was almost annihilated through the death of the silk-worms, and that was almost always indisputably caused by a fungus. A disease which had all the characteristics of an infectious epidemic resulted in consequence of the germs of the fungi being introduced into the caterpillar, and each one infected became a source of infection, which spread in the same way as infectious diseases were propagated. There was a splenetic fever known in some countries which killed many cattle, and it had been made out that it was caused by these bacteria. If they inoculated a healthy animal with it, they at once had the symptoms of the splenetic fever. A new disease had been investigated which was very fatal to pigs, which sometimes became epidemic, and which was caused by bacillus. In vaccine lymph and small-pox there were small minute bodies, and it was found that in these the infection resided, so that they were coming to this conclusion, that the whole of our great epidemics were of the same nature, and if that were correct there could be few forms of life of more importance than those in the limits of the visible, which he had been describing. In the potato-disease, when it manifested itself, the plant became blackened, and there were cottony filaments on the leaves, and they found, if followed, that they came to a network, which was devouring the tissues of the plant. After the fungus had spread itself through the whole tuber there were stems sent out with the spores, but they did not germinate in the ordinary manner. The spore had the power of locomotion, and it went on until it got some distance, then settled down, and sent out a process plundering cell after cell of the potato. This was multiplied, and the disease spread over a whole field or district. The cause of the disease was at first involved in obscurity, but it was afterward found to be active spores, which got into the body of the animal or plant and interfered with its life.—*English Mechanic.*

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* "On the Optical Powers of the Microscope," by P. G. Rylands, Vol. VII, p. 27.

On the Queen Bee, with Especial Reference to the Fertilization of Her Eggs.

BY JOHN HUNTER.

Read before the Quekett Microscopical Club, Oct. 25, 1878.

THE life history, functions, and attributes of the Hive Bee, have for more than two thousand years engaged the attention of Naturalists and other men of science. Apiarian students have numbered in their ranks men whose pre-eminent learning have left their names as landmarks to posterity, and who will never be forgotten while history exists. Among the ancient philosophers who have studied and writen upon the bee, I may mention Virgil, who devoted the whole of his Fourth Georgic to the subject; Cicero, Pliny, Aristomachus, Philiscus, Columella and Celsus; and within the present century we have the great naturalist, Swammerdam, the mathematician Maraldi, Reaumur, the inventor of the thermometer which bears his name, my illustrious namesake, John Hunter, the anatomist, and Huber, of Genoa, whose total blindness did not prevent his giving to the world many facts in the bee's life history which were before unexpected. Without approaching nearer to our own time, the above array of brilliant names as examples will sufficiently excuse any amount of attention we lesser lights may give to an insect so small, but yet of great and increasing service to mankind.

When so many learned men have been before us, it may be assumed that the subject is well worn, but the fact is, that, from the imperfect means of observation enjoyed until lately, mainly by the misconstruction of hives, facts have been so mixed up with surmises and wrong deductions drawn, that it became a difficult task to separate the true from the false. A colony of bees consists of workers which may number fifty thousand or more, in summer a few hundred drones, and *one* queen, who is the only individual in all this vast assembly capable of propagating the species. At the present time, the month of October, we may safely assume that under normal circumstances the queen in any hive is the mother of every other bee there. The drones are males, and what I have just said, will, of course, have informed you that the queen is the female; and the question naturally arises, what are the workers? They used to be styled neuters, but they are not so, they also, as well as the queen, are females, differing in the fact that their sexual organs are not fully developed. Drones, workers, and queens, of course, are all bred primarily from eggs, and those gentlemen who have made no special acquaintance with bee history, will perhaps feel surprised when I say that the eggs which produced the queen and the workers were, when deposited by the mother bee, identically of the same kind, and either could at the will of the bees, who may even be influenced by the will of the bee master, by skilfully directing them, as his agents, be made to give birth to either queens or workers—nay, I will even go further, and say, that I believe it possible that the skilful experimentalists could so direct that some selected eggs, which, left to themselves, would give eventual birth to drones, should be made to produce drones, workers, or queens at will. To elucidate this problem, I must beg your attention while I trace the history of a bee, not only from the deposition of the egg, but from the growth of the latter in the ovary of the mother, and it will also involve an explanation of the theory of Parthenogenesis.

On dissection of a queen, we find within her abdomen a pair of ovaries, as on the diagram to which I direct your attention, as also to the preparation of these organs under the microscope. We see each ovary consists of a great number of tubes, containing eggs in various stages of development, and all these tubes lead to a right or left duct which again unites into one main channel down which the eggs pass; at the side of this latter duct we find a little globular sac opening into the oviduct; this sac is called the spermatheca, and is filled, when the queen has had copulation with the male, with the usual whitish seminal fluid, containing countless thousands of spermatozoa in full activity. I have here an impregnated queen, from which I will show you it is easy to dissect out the spermatheca, and verify its contents to be as I state. Seeing these active bodies all wriggling and twisting like so many eels, it is hard to believe they are not animalcules, as was long thought. To return to the eggs: when arrived at maturity they glide down the oviduct from either ovary, and on passing the opening of the spermatheca, receive one or more spermatozoa, which, penetrating the egg's substance, causes the birth of a worker larva; but it may so happen that the egg in its passage, does not, either from volition, or inability of the queen, receive impregnation, in this case it does not perish or addle, but gives birth to a *drone* larva, and it has been conclusively proved that the act of fertilization or not determines the sex of the future bee. The egg being fertilized and deposited, it hatches in about three days, and the young larva receives the careful attention of the worker bees, who feed it with appropriate food, and in due time it passes to the pupa state, on the twenty-first day becoming a worker bee, but the same egg that produced the worker in twenty-one days could, had the bees been so minded, have been bred up to a queen in sixteen days. The bees only rear queens when necessity calls for them, either from loss of their old monarch or apprehended swarming. If I remove the queen from a hive, the first of these contingencies occurs, and after a period of a few hours' commotion, the bees select certain of the workers eggs, or even young larva, two or three days old, the cell is enlarged to five or six times its capacity, a superabundance of totally different food supplied, and the result is that, in five less days than would have been required for a worker, a queen is hatched. The marvel is inexplicable, how a mere change and greater abundance of food and more roomy lodging. should so transform the internal and external organs of any living creature. The case is without a parallel in all the animal creation—it is not a mere superficial change that has been effected, but one that penetrates far below form and structure, to the very fountain of life itself. It is a transformation alike of function, of structure, and of instinct. On the birth of the queen, her wings are limp, and hairs clotted with moisture, but she is in full activity, the workers assist in her release from the wax-cell in which her transformation takes place, but they pay very little or no attention to her so long as she remains a virgin.

The impregnation of the queen bee was long an enigma to naturalists; some have denied that any intercourse with the male was necessary for the fecundation of the eggs. Some supposed that the effluvia arising from the males within the hive was sufficient for this purpose. Maraldi thought the eggs were fecundated by the drones after they were deposited, in the same way that the spawn of fishes is fecundated; but, from our extended means of observation, we are no longer in any doubt as to the *modus operandi*. From three to seven days after birth, the queen issues from the hive, on nuptial thoughts intent, and after circling a few times round her home, apparently taking its bearings, she flies away into space; if her trip be fortunate, and she meets a drone, they fall together to the ground, where separation quickly takes place, at once fatal to the drone, who parts with his sexual organs, which remain attached to the queen on her arrival home; these quickly shrivel up, and are removed by the workers. In the act of coition the spermatheca of the queen is injected with seminal fluid, and, wonderful to relate, this small vessel whose external measurement is but 1-32 of an inch, contains sufficient material to fertilize all the eggs which the queen may lay in her whole life (for she mates but once), although she may live four or five years, and deposit during this time more than a million eggs. Dzierzon, a highly scientific German bee-master, says, "Most queens in spacious hives at a favorable season, lay 60,000 eggs in a month, and a specially fertile queen in four years, which she on an average lives, lays over 1,000,000 eggs." On this authority I make this statement, and I do not think it is an exaggeration. Referring back to my text that "the act of fertilization [of the eggs] or not—determines the sex of the future bee," you may naturally ask how I prove this statement, or that the unfertilized eggs will hatch at all. Professor von Siebold made many most skilful microscopical dissections of eggs, and he affirms that among fifty-two eggs taken from worker cells examined by him, with the greatest care and conscientiousness, thirty-four furnished a positive result, namely, the existence of seminal filaments, in which movements could even be detected in three eggs, and among twenty-seven eggs from drone cells examined with the same care and by the same method, he did not find one single seminal filament in any egg, either internally or externally. A phenomenon sometimes occurs in a beehive of a queen laying eggs that produce males only; this for ages had puzzled philosophers, without any satisfactory solution, but if you will bear in mind what I have said, and admit it as fact, the solution is easy. The theory of Parthenogenesis (or virgin breeding) which Dzierzon promulgated in 1845, is said to have explained this phenomenon of the beehive as perfectly as the Copernican hypothesis the phenomena of the heavens. The principal points to bear in mind are—that the queen to be able to breed workers must be fertilized by the drone, and that the union takes place only in the air—that drone eggs do not require fecundation, but that the co-operation of the drone is absolutely necessary when worker bees are to be produced—that in mating the ovaries are not fecundated, but the seminal receptacle (the spermatheca), and that the supply of semen thus received is sufficient for her whole life-time. We prove these hypotheses as follows:—Eggs laid in drone cells never produce aught but drones—a queen born with her wings imperfect, rendering her unable to fly, or one born after drones are all dead (generally by August), and consequently unable to mate, lays eggs indiscriminately in both drone and worker cells, but all alike produce drones. The verification of this is very easy, we have but to deprive a stock of its queen in the autumn, and provided there are eggs in the hive, young queens are sure to be reared, and as surely they will become drone breeders; the experiment has been so many times repeated that the fact is now incontestable. That a queen mates but once in her life, the introduction of the Ligurian bee into England enables us to prove. This variety has the reputation of being a better one than our own native bee—and it is a common practice to import annually from Italy fertile queens, which, by a little skilful management, are made to take the places of the rightful sovereigns in our English hives The Ligurian bee is gaily striped with yellow bands, and we quickly find the original black bees are dying out, and replaced by the easily distinguished Italians, and while this naturalized queen lives, the bees of her hive are thorough-bred Italians. I will presently dissect out, and display the contents of the spermatheca of a fertile queen, which will exhibit many thousands of the spermatozoa, with their characteristic contorted movements. I will then perform the same operation on a virgin queen, when we shall find the contents of the spermatheca a limpid fluid only, not a trace of the spermatic filaments. My namesake, the great surgeon, attempted to fertilize drone eggs by artificial impregnation from the spermatheca of a queen—he failed with the bee, but succeeded with the silkworm moth. Dr. Dönoff is stated to have been more successful, and I see no reason why the experiment should at all times fail. Cases sometimes occur, when a hive is queenless, that one or more workers will develop the power of ovipositing; it is reasonable to suppose from their diminutive size and general non-perfection of their organs, that the functions of the drone had not been performed; certain it is that eggs of a fertile worker produce drones only, and in one solitary case, where such a worker came into my hands for dissection, although I found ovaries and eggs, I could discover no spermatheca. It has been a common subject for authors to dilate upon the respect and reverence bees pay to their queen, and the valor with which they defend her. This, although very pretty, I am sorry to say, is all fable. The bees' attention to the queen is solely in interested motives, that is care for the eggs. A virgin queen receives no attention whatever, no defense is ever offered for the queen. I never hesitate to pick up a queen from the midst of her subjects, to which the bees pay no heed, and in cases where an eruption of strange workers takes place in the hive, the rightful inhabitants will suffer their queen to be seized and ill-treated by the intruders without resentment. A queen is possessed of a sting, but I have never known her to use it as a weapon, except in combat with another queen—but it is probably used to direct her ovipositor when in use.—*Journal Quekett Microscopical Club.*

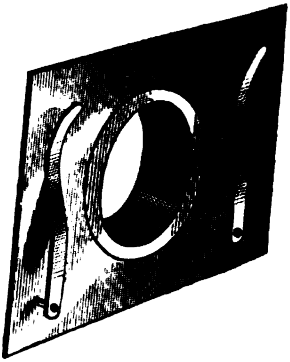
Nutriment of Bacteria.

MESSRS. DUPONT and Hoogewerff, of Rotterdam, have investigated the chemical constitution of the materials that nourish bacteria. Test tubes, like those used by Cohn, were filled with 20 c.c.m. of the nutrient fluid, and two drops of bacterium fluid, made with decomposing beans or peas, were added; the tubes having been first deprived of any atmospheric dust by hot water. Care was taken that the distilled water employed contained no organisms. Following Mayer, they prepared a normal nutrient fluid with 1 per cent. acetate of ammonia, 0.5 per cent phosphate of potash, 0.5 per cent sulphate of magnesia, and 0.5 per cent phosphate of lime. As Mayer stated, they found the most important ingredient to be phosphate of potash, and that the magnesian sulphate might be omitted without hindering the bacterium development. The following carbon compounds were tried in lieu of acetate of ammonia in the nutritive fluid. 1 per cent of carbonate of ammonia gave no development; 1 per cent of urea, and the same of ethyl-urea no development; 1 per cent formiate of ammonia, no bacteria, but some mycelium; 1 per cent formiate of potash and the same of ammonia, bacteria development; 1 per cent oxalate of ammonia, no development; 1 per cent neutral acetate of ammonia, development; 1 per cent of the acid acetate, no development; 1 per cent acetamid, development; the same with 1 per cent of glycocoll; no development with 1 per cent of sulphate of anilin. The authors were led to the conclusion that only those carbon compounds served as food for bacteria which contained "carbon atoms not united with two of their affinities to oxygen."—*Der Naturforscher.*

Sub-Stage for Oblique Light.

IN our February number we described very briefly a universal sub-stage for oblique light. The simplicity of the contrivance has attracted some attention, and at the request of several of our readers, we give an engraving and a more complete description of this simple but efficient little device.

The engraving shows the under side of the stage when in use. The flat plate is held in place by a ring or tube which projects upward from it, and which fits into the ordinary ring or tube which receives the polarizer, paraboloid, etc. The object is held against the *under* side of this sub-stage by means of two light spring clips, and it is easy to see that rays of the highest degree of obliquity may be brought to bear on it.



SUB-STAGE FOR OBLIQUE LIGHT.

Where the stage of the microscope is very thin, and consists merely of a plate of brass, glass or vulcanite, with plane sides, this contrivance is unnecessary, but with microscopes having thick rotating stages, and a sub-stage ring projecting some distance below the under side of the stage, for receiving illuminating accessories, it is is impossible to apply the slide to the under side of the stage and hold it steadily in position. The contrivance just described then becomes of great value.

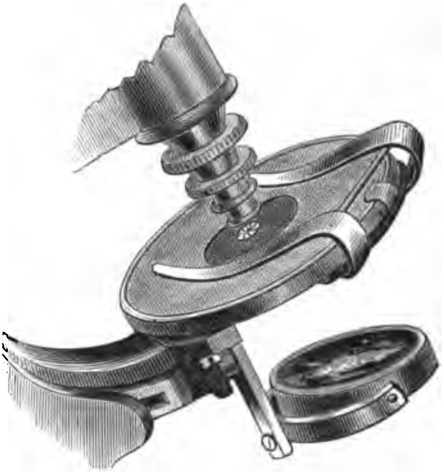
Another important feature of this sub-stage must not be overlooked. If the spring clips be made very light, this arrangement serves as a safety stage, and the most delicate slides may be used even by bunglers, without danger of having the slide or cover fractured. The value of this to those who exhibit valuable slides under high powers, such as Möller's Probe-Platte, under high-angle objectives, will be readily appreicated. At a recent meeting of a prominent society, a member who good-naturedly undertook to exhibit the Probe-Platte under a 1-10th, had his slide crushed by a little awkwardness or nervousness on the part of one of his fellow members. The use of this sub-stage would have prevented such an accident.

Rotating Clips for Cheap Microscopes.

THE rotating stage, when well made, is acknowledged to be a most important and useful addition to any microscope. It has this objection, however, that when well made it is expensive, and when badly made it is worthless. Moreover, it adds considerably to the thickness of the stage, thus interfering with the use of very oblique light.

A writer in the February number of this journal proposes to obviate these difficulties by the use of a circular clip; in the new microscope of Mr. George Wale, the same end is accomplished by means of a rotating clip, of which we give a cut. In this form the stage is circular but immovable; near the outer edge of the stage, both on the upper and the under sides, are two narrow circular grooves, in which slide two pins attached to a bar which lies beneath the stage (as shown in the cut), and which carries the clips. To the middle of this bar is attached a spring which keeps the frame of the clips in place on the stage.

This arrangement not only allows the clips to rotate round the stage, and thus permits the object to be placed in any direction as regards the light, but it enables the microscopist to remove the clips instantly from the stage, and thus leave a clear space for work when the microscope is used in a vertical position. The clips may also be placed on the under side of the stage, so as to hold the slide from beneath. In this way light of the utmost degree of obliquity may be used, as the stage then virtually has no thickness whatever.



ROTATING CLIPS.

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—Dr. Miéville of Nyon, in Switzerland, lately read before the Vaudois Society of Medicine an interesting paper on the effects of re-vaccination as practiced by him during a recent outbreak of small-pox.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

Terms—$1.00 per year.

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We can no longer supply complete sets of Volumes I and II in sheets. We have on hand a few complete copies of Vols. I and II, handsomely bound in cloth, with gilt title, price $1.25 each. Also a few copies of Vol. III, with full margins, bound in cloth, for $1.50 each.

As we desire to place a *complete* set of the Journal at the disposal of our subscribers at a moderate rate, we offer Vols. I, II, and III, bound, and the numbers for 1879, as issued, for $4.00 *net*.

Those who wish to have their numbers bound, can do so for 35 cents per volume. Mailing 12 cents additional.

Foreign Subscribers.—Subscribers in Great Britain and the Continent of Europe will be supplied at the rate of $1.20, or 5 shillings sterling per year, postage paid. Vols. I and II, bound, will be sent for 6 shillings each, postpaid. Vol. III, postpaid, for 7 shillings. Vols. I, II and III, bound, and the numbers for 1879, as issued for £1. British postage stamps received at full value for subscriptions and books in sums of 12 shillings or less.

The following gentlemen have kindly consented to act as agents for this Journal, and are authorized to receive subscriptions and advertisements:

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The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the American Journal of Microscopy. This certainly demonstrates the value of the journal as an advertising medium."

Another very extensive advertiser says: "We have advertised in several other journals, but have obtained more results from yours than from all the others put together."

Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

Removal.

FOR many years our quarters at 176 Broadway have been too small for our business, and we have been in many respects subjected to great inconvenience thereby. The difficulty and annoyance of moving at a busy season of the year, have hitherto prevented us from making a change, but at last we find ourselves compelled to secure more room and additional facilities. We have therefore leased very large and commodious premises at No. 14 Dey street, about one block from our old stand. Our office and reception rooms will be situated on the second floor (the one immediately over the store), and we propose to have them fitted up in very attractive style.

Please remember the change of address after the first of May.

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The American Society of Microscopists.

THE meeting at Buffalo next August promises to be a very large and influential gathering. The meeting occurs some days before that of the American Association for the Advancement of Science, so that members will have ample time to go from Buffalo to Saratoga, where the meeting of the A. A. A. S. is held.

Those members of the A. A. A. S. who attended the meeting of that body in 1876, well know what a liberal and warm-hearted people the inhabitants of the city of Buffalo are, and as the Microscopical Society of that city is one of the oldest and largest in the country, the members of the American Society of Microscopists may rest assured that nothing will be left undone that can contribute to their pleasure and convenience.

Our Book Table.

Rhymes of Science—Wise and Otherwise: Containing Poems by O. W. Holmes, Bret Harte, R. W. Raymond, J. W. McQ. Rankine, and others. New York: Industrial Publication Company.

In addition to several familiar pieces by well-known authors, such as the "De Sauty" of Holmes, the "Pliocene Skull," and the "Society upon the Stanislaus," by Bret Harte, this little volume contains a large number of fugitive pieces which seem never to have found a place except in the pages of some periodical. Some of these are very good—as witness the new version of "I'd be a Butterfly," and the "Tail of Long Ago," by some unknown author.

The book cannot fail to afford a good deal of amusement. Scientific men will appreciate it for the burlesque which it gives of many points in science, and others will relish it for its fun alone.

Section Cutting. A Practical Guide to the Preparation and Mounting of Sections for the Microscope; Special Prominence being given to the Subject of Animal Sections. By Sylvester Marsh. Reprinted from the London edition. With Illustrations. 12mo., cloth, gilt title. Price 75 cents. New York: Industrial Publication Company.

The majority of the most important objects studied by the microscopist, demand for their thorough examination that they be reduced to thin sections. The ordinary works on the microscope are somewhat meagre on this special branch of laboratory work, and Dr. Marsh has done good service by giving simple and yet very complete directions for all the operations connected with section cutting. To the American edition has been added notes equal in amount of matter to quite half the original work. These not only explain such English terms as *Rangoon oil*, etc., but give a very complete and fully illustrated article on the selection and keeping in order of section knives.

The Amateur's Handbook of Practical Information for the Workshop and the Laboratory. Second Edition: Greatly Enlarged. Price 15 cents. New York: Industrial Publication Company.

It is but a short time since we noticed the first edition of this work, and the rapidity with which that edition has been exhausted is very good evidence of the value of the book, as well as of the need for such a manual. The present edition has been greatly enlarged, so that it now contains the cream of the practical recipes found in the larger books and cyclopædias. Owing to the large circulation which it has attained, the publishers are enabled to give a good deal for the money.

Correspondence.

The Editor of the American Journal of Microscopy does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

On Aniline Colored Shellac Varnish.

Ed. Am. Jour. Microscopy—Having occasion lately to mount a large number of animal sections in glycerine, after the covers had been placed in position, they were cemented in place with the assistance of the turn-table, by means of a varnish composed of shellac dissolved in strong alcohol, to which was added enough aniline to color it nicely. The slides presented a handsome appearance after the varnish was dry, but after standing for a week the glycerine absorbed some of the aniline from the varnish and every specimen was spoiled in consequence. Those specimens that were finished with zinc white in place of the shellac cement, are still in excellent condition, and will probably remain so. I relate these facts in order to warn beginners not to use varnishes containing aniline colors in cementing the covers in place. The proper place to use them is only in finishing, after the covering glass is secure. H. V. H.

April 7, 1879.

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Parasites of the Entomostraca.

Ed. Am. Jour. Microscopy.—I recently saw a drawing of an encysted parasite lodged in the "abdominal segment of a cyclops" taken from the croton water of New York City.

The observer did not prosecute his examination to then discover the species, and I am now interested to trace if possible the nature of the parasite.

The drawing was made by a Mr. Charles F. Gissler, in 1871, and published by him at the time.

During the following months of the year I intend to make examination of the entomostraca of our croton supply, and I would thank any of your readers, who observe any such encysted parasites, so placed, to favor me with specimens, which will be duly acknowledged in any future publication of results.

In any case this is a study that may be taken up with profit by those who have time to prosecute it, and considerable progress has of late been made in this direction by European observers. The fact that mosquitoes carry in their probosces the much dreaded filaria of Eastern climes, has been discovered in India, and confirmed in Australia (or *vice versa*, for there is some dispute as to priority), is a fact of vital interest, and should give impetus to those who study larval forms of aquatic life.

Again we know that the origin of most internal human parasites is traced to water, passing through stages of development and adventures by land and water, which excite the wonder of those who trace their complicated history. The "*Trichina spiralis*" has never yet been observed in water, but it appears probable, if we reason by analogy, that its origin may there be traced.

I merely mention these facts to show, that the field I propose is worthy the attention of all microscopists, and to those who have not already undertaken a special study, I suggest it as one, which with a little co-operation, may bear practical results. JOHN MICHELS.

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Finishing Slides.

Ed. Am. Jour. Microscopy—I would like to suggest to my fellow beginners in the art of mounting objects, the use of an ordinary gray paper "stump," about 1-4 inch in diameter, for removing superfluous balsam from the edge of the cover, after it has been roughly cleaned away by a knife-blade or other means. The point is to be dipped into a vial of turpentine, alcohol or benzole, and the stump is then held in the fingers and used like a pencil, and is very efficient. The slide is then finished with a damp rag. A. L. WOODWARD.

Syracuse, April 9, 1879.

◆

Benzine and Benzol.—These two names are often confounded with each other. The first is usually applied to the product from petroleum, and the second to that from coal tar. They differ considerably in their properties, and as benzol is extensively used in microscopy, etc., disappointment has frequently been occasioned to those who have used benzine instead. Hager remarks that petroleum benzine, on dissolving iodine, assumes a *raspberry red* color, while coal-tar benzine becomes *violet*. Asphaltum is soluble in coal-tar benzine and insoluble in petroleum benzine.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales and purchases for cash must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Will exchange for well-mounted objects, human teeth sections from any part of tooth desired. H. A. Moyer, Kendallville, Ind.

Slides of pine pollen, so-called sulpher shower, which fell in eastern Pennsylvania, March 17. Diatoms, vegetable stainings, etc., in exchange. C. Henry Kain, 524 Cooper street, Camden, N. J.

Wanted, a good stage micrometer, in exchange for fine diatoms and other desirable material. M. A. Booth, Longmeadow, Mass.

Wanted, an achromatic condenser and fitting, or Wenham's parabolic reflector, in exchange for books on medicine, or state what is wanted, H. V. H., P. O. Box 47, Coeymans, Albany Co., N. Y.

Slides of Nummilitic limestone from Pyramid; foraminiferous limestone, India; deep sea dredgings, various parts; Sertularia. Histological or pathological specimens preferred. Dr. Chas. L. Swasey, New Bedford, Mass.

I have for exchange a Kinne self-centering turn-table with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypens, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod, and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¼ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 248, Greenport, Suffolk County, N. Y.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

VOL. IV. NEW YORK, MAY, 1879. No. 5.

Surirella Craticula, an Abnormal form of Navicula Cuspidata.

BY J. D. COX.

SOME months ago I received a very interesting slide of diatoms from Dr. W. H. Titus, of Shawano, Wis. Among the more numerous of the species was the *Navicula cuspidata*, whose beautiful and delicately striated frustules were freely scattered over the field. My attention, however, was attracted most strongly to some valves, a dozen or more in number, identical in shape with the *N. cuspidata*, but with the well marked and peculiarly arranged *canaliculi* which at once indicated that they belonged to the supposed species *Surirella craticula* (Sm.) There were the same broad and clear central space, and the rather irregular *canaliculi* covering the rest of the shell, some wider, others narrower, not quite symmetrical on the two sides of the valve, and not quite uniform in the angle at which they approach the median line. The characteristics are very perfectly given in Tuffen West's excellent engraving in Smith's "Synopsis of the British Diatomaceæ." On comparison, it would be impossible to doubt the identity of the forms.

Circumstances had recently attracted my attention to the variation of structure in the valves, or in the plates into which the valves of diatoms are sometimes divisible, and to the danger of an erroneous multiplication of species, especially in the earlier history of the investigation of the fascinating variety of forms the Diatomaceæ revealed to the microscopist. Among those whose frustules could be thus split up, the *Mastogloia*, *Rhabdonema* and *Grammatophora* were early known. Then came the *Arachnoidiscus*, whose shell was shown to have two plates, by Mr. Shadbolt, in England, and Mr. Stodder, in this country. The Algoa Bay guano from Africa gave us the *Climacosphenia* with its ladder-like plate, often found quite separated from its long and striated counterpart. Still more recently M. Paul Petit, in a paper translated by Mr. Kitton, and published in last November's number of the *Journal of the Royal Microscopical*

Society, described and figured the differing structure of the plates, making up the composite valves of a *Cocconeis* and a *Campyloneis*.

With these, among other examples in mind, proving how varied may be the appearance of valves or laminæ of valves from the same frustule, both in normal and in abnormal forms, I was prepared to accept the conclusion that a similar condition of things exists in regard to the *Navic. cuspidata* and the so-called *Surirella craticula*, when I found them in such suggestive juxtaposition. Not only were they distributed in the same gathering, but they were found lying side by side, the shells being of such identical length and form as to lead one very persuasively to believe that they were parts of one diatom, separated only in the mounting. The fact that the *Navicula* varied considerably in length, ranging from a little under four thousandths of an inch, to a little over five thousandths, made an additional link in the evidence when it was found that in most cases the shell of the *Navicula* lying *closest* to the *Surirella* so exactly matched it in size and shape. The probability thus raised was, however, only enough to make a systematic examination of all the craticular (gridiron shaped) valves an interesting task. By the aid of a low power, they were noted and located with the Maltwood finder, and then carefully examined *seriatim* with a Powell & Lealand new formula immersion eighth. They were all found to be striated, the striæ of the same fineness with the *N. cuspidata*, but following the lines of the *loculi* or *canaliculi*, so as to be in most if not all cases slightly divergent, those of the *Naviculæ* being uniformly and regularly transverse.

Two specimens were found in which the plates were plainly *in situ*, superposed as parts of one frustule. In the first of these the false *Surirella* was uppermost, clearly defined and resolved in all its parts, but by focussing through and below it, an appreciable distance, the *Navicula* valve was almost equally well displayed, a perfect mate of the former, exactly coinciding in length, breadth and form.

This seemed conclusive, but the other specimen clinched the matter. It was a finely formed frustule, lying a little tilted in the field, so that the swelling curves of the upper and lower valves could be seen in the thickness of the frustule, the shells not having been separated in the cleaning in acids, and the hoop still holding them together. In this case the diatom plainly consisted of not less than *three* valves, and possibly four—the upper and lower being *Navicula cuspidata*, and the *middle* the false *Surirella craticula*. Each in its turn could be brought into the focus of the glass, and all its distinguishing marks beautifully brought out. A little pressure on the cover glass showed that the balsam of the mounting was not fully hardened, and by continuing the pressure judiciously the valves of the frustule were made to separate, so that the lower one floated out from under the false *Surirella* plate, and the dissection of the diatom was thus complete, as well as the demonstration that the craticula plate, whether called a *Surirella* or by any other name, is properly only an occasionally occurring extra plate in the *Navicula cuspidata*, whose well known forms crowded the broad field of the well-filled slide. Fig. 1 illustrates the appearance of the last described frustule as the separation of the valves took place. Fig. 2 is a copy of the engraving of *Navicula cuspidata* in Smith's "Synopsis," and is inserted to give means of a satisfactory comparison of forms.

Corroboration for this view of the origin of *Surirella craticula*, is found in the fact that the various localities and deposits in which this form has been discovered, are almost uniformly those in which *Navicula cuspidata* is also reported. For instance, two of the three places where Mr. Smith, in his "Synopsis," says the *S. craticula* is found, are also those which he gives as localities of the *N. cuspidata*, viz., "Bramley Spring, near Guildford, Mr. Capron," and "Lough Mourne deposit." In the *Quarterly Journal of Microscopical Science* (Vol. VIII), in a report on the diatomaceæ of the neighborhood of Liverpool, by Mr. Comber, both the *N. cusp.* and *Sur. cratic.* are said to be found in Bidston Marsh, and both are reported by Mr. Geo. Norman as found in the Hornsea peat deposit, in his list of the diatomaceæ of the neighborhood of Hull, in the same volume.

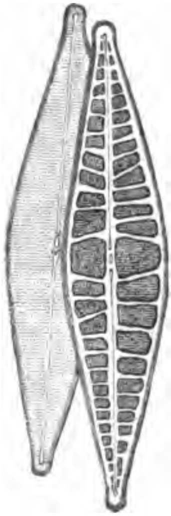

Fig. 1.

The occurrence of only a small percentage of the craticular plates among numerous frustules of the Navicula, is very strong evidence to warrant the conclusion that they are abnormal forms, and not such as to warrant their assignment to a separate species. As early as 1861, Dr. G. W. Wallich spoke of them as a monstrosity, though he made no suggestion as to the origin or relation of the form, and the English microscopists seem generally to have adhered to Mr. Smith's classification in the "Synopsis," already referred to.

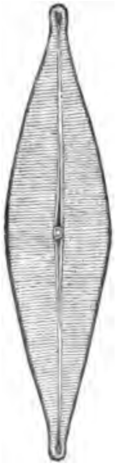

Fig. 2.

The history of the discussion would be very incomplete, however, without reference to the part taken in it by Dr. Greville, of England, and Herr Grunow, for which I am indebted to Prof. H. L. Smith.

In Dr. Greville's report on diatoms from the South Pacific, he names a genus *Stictodesmis*, to include forms in which a navicular and a craticular plate are found in the same frustule, assuming, of course, that the two are normally combined, and are not abortions or accidents. Later, Grunow, in his report of the Novara expedition, classified several of the craticular forms, including *Surirella craticula* under a genus which he called *Craticula*, the *Sur. cratic.* of Smith being named *Craticula Ehrenbergii.*

In arranging his "Conspectus of the Diatomaceæ," published in the *Lens*, Prof. H. L. Smith, recognizing the fact of the craticulate plate being an extra one accompanying navicular valves, and finding Greville's the earliest named genus for such forms, and assuming, of course, that they were normal, adopted Greville's genus *Stictodesmis* as describing it, and has arranged some new species under the generic name.

In an article on new Honduras diatoms, in Vol. XVIII of the *London Monthly Microscopical Journal*, translated by Mr. Kitton from the German of Grunow, the genus *Climaconeis* is said to be also probably an "abnormal or craticular state of *Navicula Scopulorum*, *Breb*," and Grunow further expresses the opinion that his *Craticula Ehrenbergii* (*Sur. cratic.* of W. Smith) is an abnormal form of *Navicula cuspidata*, and Mr. Kitton adds the note that, as between the names *Stictodesmis* of Greville, and *Climaconeis* of Grunow, the latter, if either, should be retained, as it had priority in time, being first published. In this, however, Mr. Kitton overlooks the fact that there is no evidence that Grunow named his genus *Climaconeis* to include forms with both navicular and craticulate plates. On the contrary, his later formation of the genus *Craticula* to receive them, proves that he did not include such in the former genus. But as Greville's *Stictodesmis* undeniably preceded Grunow's *Craticula*, Prof. H. L. Smith only followed the established rule in adopting Greville's name for the genus in his "Conspectus."

In the paper on the Honduras diatoms referred to, Grunow does not give the evidence on which he bases his conclusion that the craticulate forms are abnormal, and I had not noticed the remark at the time the observations were made which are the subject of this article. While, therefore, I cannot claim originality in the conclusion reached, the evidence itself loses nothing of its importance as bearing directly on the question whether all writers hitherto have not recognized new genera made out of forms which are only occasional varieties, and not normal growths having the power of propagating themselves in continuing generations. If this be true in regard to *Surirella craticula*, it is of little consequence whether the name given by W. Smith, Greville or Grunow be preferred, for all must be abandoned. The discussion of the literature of the subject, therefore, is only pertinent as establishing part of the "truth of history" in respect to an interesting subject.

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A Few Notes on Part III Diatoms, edited by Cleve and Moller, Nos. 109-168. By H. L. Smith, Hon. F. R. M. S.

I SHALL make these notes very brief, and only with a view of adding, if possible, to the real value of this excellent series of slides, which have passed under the revision of the well known authority, M. Grunow. To a certain extent the miscellaneous character of the slides (for few are what one would call pure gatherings), will make them more valuable to those who desire to obtain as many species as possible in the smallest compass, or, where limited means forbid them to indulge liberally in picked out specimens. And yet, there are disadvantages; the enumeration of some fifteen species, as in many of these slides, to over one hundred and seventy, as in Nos. 155, 156, will but confuse a student, who, with but a very limited library, will be utterly unable to determine which are the diatoms named, and indeed it would puzzle even an expert to find some of them. In this view, the collection is more valuable to the advanced student, and to one who has collected the literature, scattered throughout numerous journals, and in various languages, much of which is utterly inaccessible to the ordinary student. I do not make these remarks as in any way depreciating the value of this series of slides; to one familiar with the subject, they are, after the examination by so competent an authority as Herr Grunow, simply invaluable; for the poor student's sake, however, and in view of the notorious want of a good treatise on the diatoms, one could wish that some means had been adopted to register, or mark the new species, or the rarer ones, but this could not be done without increasing the price.

No. 114. *Coscinodiscus radiatus.* I cannot admit that the Coscinodiscus on this slide is *C. radiatus*, which is an exceedingly common form in all soundings from equatorial regions. The figure of this species, in the "Synopsis of British Diatomaceæ," is good enough, better than Kutzing's; it has a narrow but not striated marginal rim, whereas all the specimens in the slide No. 114, unless they have been injured, have a pretty wide striated border, and the species, it seems to me, is clearly *C. marginatus*, E., which is also abundant in soundings, particularly off the N. W. coast of North America, and it is not uncommon in the Californian and Peruvian fossil deposits.

No. 115. *Actinocyclus Ralfsii*, W. S. var., *Yarrensis*, Grun. This is scarcely a variety of the beautiful *A. Ralfsii*, which not only has a very different aspect and color, but is furnished with a distinct intra-marginal pseudo-nodule. True, the latter may not be worth considering as of specific value, and if so, by all means let us cease giving a new name to every little Navicula e. g. which may chance to vary somewhat in outline from anything we have before seen. At present, however, while the presence or absence of the nodule is of no generic value, it is admitted as a good species character. The Yarra Yarra Actinocyclus, is the *Coscinodiscus fuscus* of Norman, and, as it appears to me, sufficiently distinct from *A. Ralfsii*, which has a very brilliant look compared with this dark Australian specimen, which well merits its specific name, and should be termed *A. fuscus*.

No. 116. *Biddulphia Edwardsii.* I suppose this diatom may, for the present, be considered a distinct species. There is little doubt, however, it is a hirsute variety of *B. Roperiana*, Grev., quite analagous to a similar variety of *Melosira Borrerii*, lately found by Castracane.

No. 124. *Nitzschia palea*, var. Curta. This is doubtfully, N. palea of K., it is very like his *Synedra fusidium* = *Nitzschia*, of which I have specimens from Dr. Arnott.

No. 125. *Thallassiothrix longissima*, Cl. et Grun. This is a very remarkable diatom, and the gathering is quite pure. It is allied to Synedra, but entirely different; it is more or less sigmoid, and the chief peculiarity is a distinct serrated or notched margin. The whole appearance is not unlike the horns of a large Chætoceros.

No. 137. By mistake, a slide of *Nitzschia perpusilla*, from Bohuslan, Sweden, has been labeled with this number as *Amphora pediculus*, K.; it is the same as No. 362 of my own "Species Typicæ." The *Amphora pediculus* will be given in the next issue of Cleve and Möller.

No. 143. *Navicula fusiformis*, v. *Ostrearia*, Grun. It is impossible to believe that this is the diatom figured by M. Grunow in his paper on Honduras diatoms, and in which he shows a small central nodule, for nothing of the sort is found in the present specimen, nor indeed should be, seeing that it is only *Diatoma hyalinum*. W. Smith's figure of the valve of this species shows it somewhat broader than are the valves in this slide, there are numerous specimens in f. v. cohering, and showing plainly that the diatom is *D. hyalinum* and not a *Navicula*. Many years ago I received from Brebisson a gathering marked ***Amphipleura danica***, var. *Ostrearia*, which was a *Navicula*, quite like Grunow's *N. fusiformis*, only it was much more finely marked, 82 in .001″. Subsequently, I obtained another gathering from Grimsby, England, which was quite like the *A. danica* of Breb., but was not oval, and showed the central dot, or nodule, more clearly. Although smaller than Kutzing's *Navicula Oxyphylla*, judging from his figure, it agreed upon the whole so well with this, I issued it in my series under that name, as No. 302, while No. 15 is the form called *Amphipleura danica* by Brebisson.

No. 144. *Navicula Hilseana*, Janisch, v. (*N. Brauniana*, Grun.) There was really no need of a new name for this species, and Cleve and Möller have rendered a good service by giving it in their series, because now, one can judge intelligently. It is clearly only a variety of *Navicula interrupta*, in fact, very close to Gregory's *Pinnularia* (*Navicula*) *globiceps*, a gathering of which I have, scarcely differing from the present form.

No. 148. Diatoms from Barbadoes. The gathering, from which this preparation comes, was made by my friend, the late Capt. J. A. Perry, and was sent by me to Mr. Febiger. The slide No. 205 of my series, is from a portion of the same gathering, prepared by Dr. Warren, but after all, some of the best things in it, notably the so-called *Auricula* of Castracane, the *Amphora complexa* oı Gregory, are best seen in preparations made without the acid treatment. The *Isthmia Lindigiana*, Grun., named by Cleve and Möller as found in this gathering, is the *I. minima* of Harvey and Bailey, No. 205 of my own "Species Typicæ."

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Some Remarks on Microscopical Manipulation.

BY PROF. H. L. SMITH, HON. F. R. M. S.

In the March number of this journal was an interesting article by Mr. C. M. Vorce, on, what I believe I first described, as a mechanical finger, and a certain modification of it, which is substantially that proposed by Mr. Samuel Wells, of Boston, and which, with slight variations, is now the form generally used. There is no need to describe these modifications; they will suggest themselves to each one desiring to construct it, according to his ability, or the instrumental means at hand. I wish, in the present communication, to give some hints which will greatly facilitate the use of the "finger," and remedy some of the difficulties experienced by a beginner in using it.

Simple as are the means which I shall describe, they are the fruit of long experience, and I shall be glad if I can make this experience useful to those just entering upon microscopical studies, for I am sure it will save much valuable time, and conduce to general morality. I hold the bristle, or picker, in spring forceps, and after adjustment, put a drop of sealing wax on the forceps to bind all tight.

To make this bristle, cut a narrow slip of glass, and by means of a spirit lamp, draw it out into a slender thread; snip off the thread by a knife, in such manner as to present a beveled edge, as shown in Fig. 1, (of course the figure is much magnified). This thread of glass is so fine as to be quite flexible, and it is clean, or if dirtied it can easily be cleaned, and it is not affected by moisture, applied as I shall describe presently, *a very important point.* It will often be easy to pick up a diatom, or other small object, by simply touching the point to the slide, and then, by depressing the tube of the instrument, causing it to slide forward on the glass plate till the diatom, or object, is dislodged. My own modification of the "finger" has the Society screw, and will receive any objective, though I prefer generally a 2-3 inch. It is shown in Fig. 2. When the screw, A, is loosened, the ring, B, and the hair, C, can be revolved, and the hair made to point towards the centre of the field in any required direction, which will be found convenient for pushing a diatom into place, in arranging in lines, or circles, as I shall describe presently. The objective screws in at D, and by raising or depressing the rod, E, the point of the hair can be brought into focus. The glass hair should point downwards at a slight angle. If, now, when it has been brought into focus, one will unscrew the front lens of the objective slightly, this will throw the point out of focus, and now the objective, with its front thus partly unscrewed, may, by the rack, be brought down to give a distinct view of the material from which the object is to be picked, *without any danger of the hair point touching it.* When the object is found, then by turning home the unscrewed front lens, the point will come into focus, and now, by slightly racking down the tube, the point can be made to touch the object, and by racking back to lift it. If some dirt, or other object, is raised, a light tap on the tube of the instrument will instantly set it free, and leave the glass hair clean, or it may be

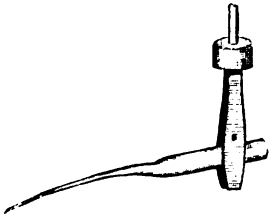

Fig. 1.

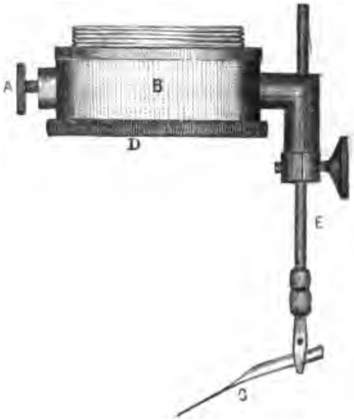

Fig. 2.

cautiously wiped off with a little tissue paper. One of the greatest objections to ordinary bristles, hairs, etc., is, that after lifting a small diatom, it is often impossible to make it let go, on touching the place where one wishes to deposit it, a difficulty rarely experienced with the glass hair. Although the glass hair is somewhat brittle, yet, with care, it may be used a long while, and any time can be easily replaced. I spread the material from which the selection is to be made, on a piece of thin glass, and generally heat it red hot, if it contains diatoms, to burn out the organic matter; this piece of thin glass I attach to an ordinary glass slide, a little to the left of the centre; and to the right of the centre I put on the same slide the cleaned glass cover, to receive the picked out specimens, and directly under the centre of this cover, on the under surface of the slide, I place a small ink-dot, which can be easily recognized though out of focus, when one, having secured the object on the end of the hair, now pushes the slide along to bring the cover into view. In this way one can readily pass from the crude material to the cover, without danger of detaching the little specimen picked up. If the specimens are to be mounted in balsam, it is necessary to put a little thin solution of gelatine on the cover, and dry it, as Mr. Vorce mentions, but to save trouble, such as fermentation of the solution, and a thousand other mishaps, I adopt the following plan: A single shred of Cox's gelatine is attached to the cork of a homœopathic vial, in which vial it is to be kept, to be away from dust (see Fig. 3).

When the cover is cleaned, I put a minute drop of distilled water on it, and then rub the shred of gelatine, lifted out of the vial by the cork, in the water a little while, and even if this leaves a barely perceptible spot when dried, which will be before one can pick up the object, it will not show in balsam, neither is it necessary to use any turpentine, as directed by Mr. Vorce. The fact is, any collection of diatoms, large or small, will mount perfectly, without air-bubbles (or if they show ever so badly at first, they will disappear), by using the prepared balsam of Markoe, Boston. I have found nothing like it, and it can be used till it is quite thick, and then it can be diluted with a little of the thinner. The slides must be warmed a day or two, on a steam register or heating box, and should be placed upside down, so that, if any object is dislodged from the cover, it will still be found in contact with it, when the balsam is hardened. Of course the slide must be supported so that the cover will not be touched.

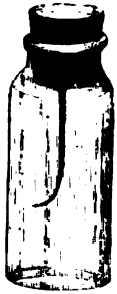

Fig. 3.

I come now to the principal part of the manipulation, the method of taking off the diatom, or object, just where and when we wish, and also to the method of arranging into lines, circles, etc.; this process is not my own as to idea; I have reason to believe it is, substantially, that used by the professional preparers of these objects, though it has never before been made known; for explanation I refer to Fig. 4, which shews the microscope with the finger attached at *a*, and the hair just above the slide; *b* is a glass tube having a bulb or enlargement as shown, and attached some way to the stand; a short bit of tube slides into the end nearest the stage, and may be drawn out till it nearly touches the slide; to the other end of the glass tube is attached a rubber tube, *c*, with a mouth piece. When the object, on the end of the bristle or hair, is brought directly over where it is desired to be placed on the cover, the tube is carefully racked down till the object nearly touches the cover; now, by gently breathing through the tube, a film of moisture will form on the cover, in the most beautiful manner if the tube be pointed right at its lower end, and will, if we stop breathing, again quickly disappear. Suppose, now, we flood the cover with moisture, and depress the tube, the hair touching it, the object will be at once taken off, and now by a little manipulation, not easily described, but easily performed, and mainly consisting in so placing the hair by revolving the ring, that its point, slipping forward on the glass, as the tube is depressed, will push the object here or there, into lines or circles, without danger of its flying off, or being again picked up, if we keep the cover moistened by gently breathing. It is astonishing how gentle a breath will flood the cover with moisture, and one must be very careful not to blow through the tube before the object is dislodged, or it will inevitably be blown away. When the moisture evaporates, as it will at once, the gelatine will hold all fast, and then there is no need of any heating of the cover, which might do harm by possibly charring the gelatine, only one must be sure it is really dry before placing it on the little drop of balsam on the slide. The bulb, *b*, catches the condensed moisture, and must be emptied occasionally.

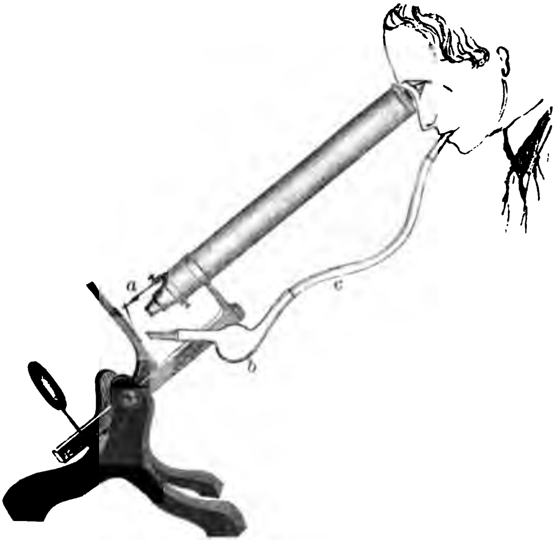

Fig. 4.

I find that a disc of colored wax, with a little hole punched in the centre, answers very well to protect large diatoms from being smashed, and if, when the balsam has hardened, a finishing ring of black is added, it will make a handsome mount. Of course, no heat must be applied, to melt the wax. It sometimes happens that something like crystals or filaments will appear, apparently dissolved, or drawn out of the wax by the balsam, but they will, after a little time, disappear. There are numerous "dodges," if I may be allowed this word, which, if I had time to detail them, would save the young microscopist a great deal of trouble, but I cannot find time to give them now.

Practical Hints on the Preparation of Opaque Objects for Microscopical Examination.

Read before the Buffalo Microscopical Club, May 13, 1879, by Geo. E. Fell, C. E.

THE preparation of objects for microscopical examination embraces an extensive variety of methods. The great diversity in the nature and structure of the material and objects which are subject to such examination, taking in the *minutiæ* of the greater portion of the field of nature, would lead to such an inference. To the most uninformed it would appear reasonable to suppose that there should be a difference in the method of preparation of a portion of the human tissue, and a valued geological specimen; and again, when it is understood that most objects may be viewed by two different methods of illumination,—by transmitting the light through them when made sufficiently thin or transparent to permit its passage, and by condensing or reflecting the light upon, and examining the object by the reflected rays which pass directly from it through the microscope to the observer's eye—it will be seen, that not only different material requires different methods of preparation, but it may be stated that each object in itself often requires to be mounted in different preservative media, after undergoing a variety of processes, previous to observation, and before its structure can be satisfactorily differentiated.

The objects mounted in fluid are generally made transparent, viewed with transmitted light, and are in contrast to the opaque preparations, which are usually exhibited in their natural condition.

The preparation of the latter, as this paper will not admit more, for accessible and convenient observation, will be principally the subject of my remarks this evening, and I will endeavor to explain the method adopted by myself in the preparation of the slides I have with me. An agreeable correspondent desious of preparing slides similar to these, wrote me, saying, "do not give instructions in general terms, and close with mount objects" as usual—but explain matters for A. B. C. Darians in mounting. It won't hurt the adepts, and the novices will get clear ideas. I remember an article published not long since, exceedingly interesting in its suggestiveness, but deficient in clearness in describing the critical operation. The essential point of all, the writer afterward failed to make clear, (he did not say intentionally) in reply to a query touching this very point, so easy is it to do a thing well, and yet fail to make words do the office of "sight-seeing."

Whether I will be subject to similar criticism remains for your determination. If my explanations are not clear your "sight-seeing" may aid you, as I have with me a series of slides in different stages of preparation, also the material and apparatus necessary to the complete process.

My apology for taking up the greater portion of your time in describing the wax method of preparing slides—is, that I have seen no similar preparations, at our meetings, by other members of the Club, and am inclined to believe that but few, if any, have given the subject any practical consideration. It is of value to all who work with the microscope as presenting the most expeditious and satisfactory method of preparing opaque slides, and, in my opinion, is far superior to the old methods of preparation (by applying different cements for back grounds), which were slow and difficult in preparation, incomparable to the wax when complete, and uncertain as to durability, when exposed to ordinary high temperature. The method I use is the result of considerable practical experience, after having tried the different plans published from time to time in our microscopic journals.

It will be well to enumerate the *material*, *appliances* and *process* in order, and under the head of the former we will require

1st. The ordinary glass slips (ground edges) three by one inches in size.

2d. Tin or brass cells. I prefer the common brass curtain rings 5-8 of an inch in external diameter. They may be procured at the paper hangers or carpet stores, and for shallow cells will have to be flattened by compression.

3d. Thin glass circular covers 5-8, 3-16 or one 1-4 of an inch in diameter. The first mentioned to form the top of the cell and fit the brass rings. The size of cells and covers may be varied at will.

4th. Shellac, sealing wax, and white zinc cements with brush fitted in corks.

5th. A bottle of turpentine.

6th. Three or four small camels hair pencils.

7th. The ordinary wax of which wax flowers are made. It may be procured of the druggist in the form of white cakes three or four inches in diameter and about half an inch thick, or in sheets from the artists supply stores. The latter are generally colored and the most expensive. I do not recommend them. The wax may be colored by using oil colors. Those put up in tin tubes I find the best and they should be thinned with turpentine for the purpose. Melt the wax in a suitable vessel, stir in the paint and mix thoroughly when hot. As the wax is often impure and well supplied with foreign particles (particularly the sheet wax), I have ascertained that by heating and filtering through a wire sieve of eighty or ninety meshes to the inch, they may be removed, leaving it in fine condition, so that the subsequent operations may be performed with greater certainty of success, and with less trouble. When using the white wax cakes, if care is taken in coloring not to admit particles of dirt, this will be entirely unnecessary.

Under the head of *appliances* we will require

1st. Two small ladles furnished with tube spouts for heating the wax.

2d. A good turn-table. A poor one is worse than useless and a source of tribulation to its owner. From economical motive alone I would recommend the procuring of the best *self centering* table with the *ordinary clips* attached, from the established makers.

3d. A spirit lamp for heating purposes. The ordinary lamp will answer;

but for convenience it would be well to have one supplied with a bent tube (projecting an inch or so laterallly from the side of the lamp) to carry the wick and permit the flame to be placed near the centre of the turn-table when in use.

4th. An ordinary blow-pipe.

5th. A good hot stand.

We are now ready to prepare our slides, and with the supposition that we have a goodly supply of suitable material which we wish to preserve and have convenient access to for observation and study, will proceed with our *process* as follows:

1st. Centre a glass slip on the turn-table, and with brush charged with the crimson shellac cement, which has been allowed to become quite thick by evaporation, run several rings upon the slide and within the diameter of the five eighth inch brass cell. If desired the sealing wax cement may be used instead. Then quickly, with the white zinc cement, run one or two additional rings between, and so as to touch the shellac cement already applied. This is about all that is required to form a ground for the wax. The *marbling* process which takes place when the cements are made to run together, produces the ornamental back ground you see on my slides. I have spoken of the crimson shellac and white zinc cements for this purpose, but any colors the preparer chooses may be used, as the cement makes a better ground for the wax to adhere to than the smooth glass, and a great many different and beautiful designs may be made by using different colored cements; also, that the time occupied in producing this ground is inconsiderable. I am inclined to deem it a desirable innovation for this purpose. It is well to have the cement applied plentifully, so as to produce a thick body, as it is then less liable to be affected by the subsequent application of the heated wax.

2nd. After the cement ground has become thoroughly dry and hard (which takes but a short time when using the shellac cement) we apply the wax, which has been heated in one of the ladles, by pouring a sufficient amount to nicely cover the cement ground on the slide. If we pour too great a quantity, by simply careening the slide the surplus may be made to run into ladle number two, which should be kept conveniently near for this purpose. Our slides are now in a somewhat unsightly condition. In most cases the wax will be uniformly spread over the central portion. If it should be irregular, with hills and valleys of comparatively large proportions, we need not be in the least disconcerted, but with a knife blade shave them away, making it somewhat smooth. This may generally be omitted unless it so desirable to economize in wax.

3d. The next step is to centre the slides on the turntable, and with a heated needle point (set in handle) make a circular mark in the wax about three-fourths of an inch in diameter, also another just inside of the inner diameter of the cell, when centered, or about one-half inch in diameter.

4th. Apply the brass ring or cell when *cold*, and centre by aid of the circles just described. This has none of the disadvantages of the customary method of applying the ring or cell when hot and held by the forceps. I have found it difficult to successively centre any number of cells in this manner, as the moment the hot ring touches the wax, whether in the right place or not, it is held by it, the wax cool'ng so quickly as to prevent re-centering without renewing the whole work.

5th. We will now proceed to the critical part of the operation, the imbedding of the ring in the wax, and the formation of the cell. The slide is again placed on the turn-table which is made to revolve at a slow rate of speed. With the *Blowpipe* we throw the intensified heat from the flame of the spirit lamp, (it being held near the turn-table), upon the revolving slide, thus insuring a continuous and uniform application of the heat over all portions of the wax.

The result is that our cell immediately assumes beautiful proportions. The melted wax evenly distributes itself throughout the circumference of the brass ring, which is fixed securely in place and already centered, and throughout the cell, making it more or less concave, according to the amount of heat applied. The wax cools quickly, leaving a dim lustre to the back ground, with a smoothness and regularity unobtainable in using the sheet wax discs, or by the application of the heat in any other manner I am aware of. The retarded revolution of the turn-table prevents the heated wax from being thrown off tangentially by centrifugal force.

Should inequalities appear in the cell, owing to foreign particles being left in the wax by any oversight, they may be covered up by the addition of a little clear wax and reheating with the blowpipe and lamp. Too great a quantity of wax in cell may be removed by turning out a portion with a knife blade, and reheating as above. These suggestions will be of only occasional value.

I am inclined to favor the above method of preparing the cell in place of the customary wax disc method, believing that it leaves the wax in the finest condition possible as a ground for the object by the peculiar manner of heating. It is simple, certain, and any injury to the cell is easily remedied by reheating. I ascertained that the disc method required the exercise of great care in the securing of the discs to the glass by heating from below, the *usual* custom. Too much heat caused the discs to melt, and in spreading over the glass the wax contained in them formed too thin and transparent a back ground. A slight excess of heat produced blisters in the discs, owing to the expansion of the air beneath them; these were difficult to remove. If we consider the neatness of the preparation as of value, we have another point in favor of the *Blow-pipe* method.

6th. The next thing in order, might be supposed to be the cleaning away of the superfluous wax exterior to the cell, but as there are in the preparation of microscopic slides "many a slip 'twixt the cup and lip" of completion, experience has taught me that it is best to forego this portion of the work until the object is encased in the cell and the cover glass secure in place. We will therefore consider the different methods of securing our objects or material to the wax, in a permanent manner. The turn-table is again brought into play and slide centered. With a camel's hair pencil saturated with turpentine, make a circle in the centre of the wax cell of about one fourth of an inch in diameter or of the size we wish our objects to occupy. In doing this use the brush lightly or we will disfigure the cell. After the superfluous turpentine has evaporated, which experience will determine, we drop sufficient of the material consisting of fine *Spiculæ*, *Foraminifera*, *Polycistina*, *Fine seeds*, many *spores*, or anything dry of about similar size, upon and to completely cover the turpentine in the cell. Place aside for a few minutes until the wax dries, after which reverse the slide and strike it two or three sharp blows with a knife blade. The superabundant material will fall into the receptacle we have provided for it, so that none be wasted, leaving sufficient for observation nicely distributed in the centre of the cell where the turpentine was applied.

For dry sections of *Plants*, *Algæ* with *Diatoms in situ*, or objects of *comparatively bulky proportions*, the cell may be slightly warmed over the lamp, and the object, previously ready and adhering to a moist camel's hair pencil, quickly placed in position and lightly pressed with the pencil. For objects in fluid which we wish to view with reflected light, a different plan must be adopted. I have devised one to be used with the wax ground which for many purposes is convenient. We will assume *Stephanodiscus Niagaræ* in a fluid as the material we wish to prepare, it being a representative of many varieties, which can be beautifully shown by this method. We might place a drop of the fluid containing the diatoms or other material in the centre of our wax cell, and allow the fluid to evaporate, leaving the material in place, but this would be troublesome, the slide would need to be protected from the dust, and any movement previous to the complete evaporation of the fluid would displace the diatoms and cause them to be unevenly distributed. To obviate the uncertainty of this plan we will proceed as if we were to mount the objects in balsam. Take one of the 3-16 or 1-4 inch thin glass covers, and after cleaning, place on hot stand. Before any heat is applied, take up some of the fluid material with a pipette and allow a large drop to fall on the glass cover, having previously breathed upon it, to insure the spreading of the fluid over its surface. With the spirit lamp apply sufficient heat to prevent rapid evaporation without boiling. If our diatoms are in alcohol and water, we will notice the *pedetic* motion produced by evaporation, which often causes them to cohere in masses. If this takes place they may be redistributed over the cover glass, by placing a red-hot needle point in the fluid containing them, and if necessary repeating it. This causes a sudden ebullition, separation and distribution of the diatoms, and is appliable so far as distribution of material goes, to *balsam* mounts generally. A more perfect distribution could be obtained by removing the alcohol entirely by burning or evaporating, leaving the material in water alone before placing on the thin glass discs.

The small glass circle (having partly cooled) with the material evenly distributed upon it, is carefully placed in the centre of the wax cell. This is easily done by pushing it *carefully* to the edge of the hot stand and allowing it to fall into the cell, which is held close to the hot stand, and so as to prevent the thin cover from turning over as it drops into it. The slide is then placed on the turntable, the thin glass centered in the cell by using a needle point, the table set in motion, and with the spirit lamp and blow pipe we settle the circle into the wax so as to secure it permanently, and make a very neat preparation. This as you see is also a time saving method.

7th. Having our object securely fixed in the cell, we apply the cover glass immediately (to preserve it from the dust), by placing on the turn-table and running a ring of the crimson shellac cement around the sides and top of the cell. The 5-8 inch cover glass, after having been cleaned, is placed on top and pressed slightly into the cement. The turn-table is again revolved and another ring of the shellac cement run around the edge of the cover glass, which hermetically seals the cell. It is not necessary to wait until the first application of the shellac cement becomes hard before applying the second, as there is very little danger of its running in under the cover, and in this property the value of this cement is apparent. The Brunswick Black and White Zinc Cements I cannot recommend for this purpose. Those who have used them, know how uncertain and liable to run "in under" and destroy the objects, even after it is thought to be secure for time. Unless perfectly dry and hard they cannot be trusted. For ornamentation they answer very well.

8th. Apply a temporary label to the back of the slide before proceeding any further. It is well to acquire this habit, as it takes but a short time to forget the nomenclature of a specimen when any number of varied slides are being made.

9th. Clean away the superfluous wax exterior to the cell with the blade of a knife working close to the cell. Don't be afraid of decentering the cell; in all my experience I have not loosened one in cleaning away the wax, although there seems to be a prevailing impression on the part of many experienced preparers that the wax will not make a strong and safe preparation; and I must say that I held similar views when I was first informed of its use for this purpose by Prof. H. L. Smith. To satisfy you that there is no foundation for such views I experimented and ascertained that it required the application of at least twelve pounds pressure to remove the cell when secured in the manner I have before explained (with the cement and wax combined). The wax which is left after using the knife blade may be entirely removed with a cloth saturated with turpentine. A *slight* heating of the wax or cloth by holding over a lamp or flame, will materially hasten the cleaning.

10th. In finishing the slide we again place on the turn-table, and "run" a ring or two of the shellac cement a slight distance outside of the brass cell so as to smooth off any irregularities on the surface of the same. We may now, after labeling and removing the temporary label, call it completed; however, to meet the objections to the shellac cement preparations, viz.: that in time it becomes brittle, so that a sudden jar may dislodge the covers, we will run a ring of the white zinc, Brunswick black, or any of the prevalent cements of which turpentine is a solvent, over the shellac, and ornament in any manner desired. This does away with the objections to the shellac cement as an entirety, and admits its use for all purposes where we require a quick drying cement. The slide may be left for months before applying the final coatings.

I expected to give you practical hints on the preparation of objects in different media, as well as in the wax opaque preparations, but find that to do the subject justice would require considerably more time than the Club or myself have at our disposal this evening, in view of the interesting paper yet to be presented by Dr. Howe.

The Preparation of Insects for Microscopical Examination.

BY H. M. J. UNDERHILL.

THERE is a great deal of literature on the subject of "microscopical mounting," and I hesitated much before I decided to contribute yet another paper to the amount. Notwithstanding, I believe that the particular branch of "mounting" of which this article treats, is but imperfectly understood. When I was a member of the Postal Microscopical Society, I used to see the slides of some hundred and twenty microscopists, among which were a great many of what the club calls "professional slides." It seemed to me that the majority of the entomological specimens, both those by "amateurs" and "professionals," were badly set up, and that with a few agreeable exceptions, even those which might be called good slides were mounted upon principles radically faulty. This being a fairly large circle from which to judge, I suppose that most entomologists who use a microscope set up their preparations after the same fashion, and there fore I have written a paper on a well-worn theme.

A man commencing the study of insect-anatomy reads a few "hints on mounting" in some book; the remarks treat of mounting in general, and the beginner applies to insects methods suitable to histological, vegetable, or mineral objects. His principles are at fault, and his productions are more or less failures. This paper is not about mounting in general, and, although many of the methods detailed may be good for other classes of objects, it is only for the preparation of insects and similar things that they are here recommended.

In preparing any object, one's aim should be to obtain an absolute correct idea of it. One should therefore endeavor firstly to set it up in a natural manner and position, and secondly to display every detail. It is always to be borne in mind that details shown by distortion give an incorrect idea of the object, and that the knowledge thus gained being inaccurate, is therefore nearly useless.

By the ordinary method of preparing insects, everything is sacrificed to the display of minute details, and preparers are ambitious of doing on one slide what can only be properly done on two, three, or four. This ambition results in a radical fault, namely the use of undue pressure, in order to bring all parts of the object to one level. Again, a wish to mount slides rapidly, induces the employment of heat in order to harden the balsam quickly. For mounting diatoms, a skilful manipulator tells me that hardening the balsam thus brings out the markings. His slides fully bear out his words. But for insects, nothing can be worse than heat, for it produces an opalescent transparency, which makes markings partially invisible, and this effect is aided by the increased density given to the balsam.

The methods which I venture to recommend avoid the use of undue pressure and of heat, while, at the same time, not only will they give a better general idea of an object than the methods ordinarily in use, but also will bring out details much more distinctly.

Insects cannot all be mounted in the same way, and, according to the points which it is desired to show, so must the method of mounting vary. I will first describe the various media and processes of mounting, and then say something of the different insects for which they are suited.

The media I employ may be divided into two classes: A, those which are aqueous, and B, those which are resinous.

CLASS A. *Medium* 1.—To every fluid ounce of glycerine add ten drops of ordinary acetic acid. Almost everything may be mounted in this medium. *Medium* 2.—Glycerine jelly. For details of its manufacture I refer readers to *Science Gossip* 1874, p. 54. Carbolic acid should be used to prevent the growth of fungi, instead of Baric chloride as there stated. I do not recommend glycerine jelly, except in a very few instances, and therefore I do not trouble the reader with what I said at a former time. *Medium* 3.—Distilled water. To every fluid ounce of water add twenty drops of carbolic acid; boil until the acid be dissolved, and filter through blotting-paper. This medium is solely for mounting specimens of opaque objects.

Class B. *Medium* 1.—Canada balsam. I consider test-tubes by far the most convenient vessels in which to keep this resin. Fill a test-tube with two-thirds of old balsam and one-third of benzine. A friend tells me that new balsam does just as well, but of that I have no experience. The mixture should be of the consistency of cream. *Medium* 2.—Gum dammar. Take two parts of gum dammar and one part of gum mastic: pound them in a mortar, and fill a test-tube quite full of the powder, but do not ram it down; now pour in benzine until the test-tube will hold no more. Cork the tube tightly, and let it stand in an oven for a few hours, until the solution be quite clear and all sediment has sunk to the bottom. Filtering is quite unnecessary. Gum dammar by itself dries very brittle, and besides, I have never been able to clarify it. These mixtures of Canada balsam and of gum dammar may be used indifferently for unstained specimens. I do not know that one is better than the other, but for stained specimens it is better to use only gum dammar, because the natural oils in the balsam cause some colors to fade.

Process I. *To mount an object in glycerine.*—A cell is necessary for all but the very thinnest objects. Fixing a cell is some trouble, but it is seldom that anything deeper is required than a glass slip with a countersunk cell. As some people are always complaining (quite needlessly) of the difficulty of "sealing cells," I describe my method: fill the cell with glycerine; pick out all air bubbles with a pair of forceps, put the object in the cell; take up the thin glass cover with the forceps, breathe on its underside, and place it carefully (do not drop it) on the cell; press the cover down, taking care to keep the object in the middle, and secure it with a clip. Leave the slide for an hour in order that all superfluous glycerine may be pressed out; then take it up and wash it in clean water by dipping it in, and moving it gently backward and forward. Wipe the ends of the slide with a towel; absorb all the water about the cover with blotting-paper, and then varnish it *very thinly* with "Bell's cement." Knotting varnish, such as is sold in ordinary oil shops will answer the purpose, but slides sealed with this are apt to leak. Therefore I prefer Bell's cement, which can be bought at C. Baker's, High Holborn. Three coats of varnish should be put on before the clip is taken off, and the slide may then be "ringed" on the turn-table in any way that suits the mounter's fancy,

For mounting in jelly I again refer readers to the back number of *Science Gossip*. Objects may be mounted in water in the same way as in glycerine; washing the slide after putting on the clip, however, is unnecessary.

Process II. *To mount in balsam or dammar.*—With a turn-table draw a ring of water color paint in the middle of the slide. If the object be very thin put a small drop of the medium on the slide, place the object in it, and put on the cover, wetted with benzine, and press it down only very lightly indeed. It is but seldom that entomological objects are thin enough for this, so, in an ordinary way proceed as follows. On the ring of paint at equal distances apart, place three small chips of cover glass of a thickness just slightly less than that of the object to be mounted; arrange the object which should be quite wet with benzine, in the middle; put on the cover, secure it with a clip, and let the medium run under by capillary attraction. All bubbles not inside the object will ultimately disappear, but sometimes they need "coaxing" to make them go. The clip must be left on for half a day or a week, according to the nature of the object. Any shrinkage of balsam from the edge of the cover must be carefully filled up. Slides mounted in this way should be left at least six weeks to dry. The superfluous balsam may be scraped off neatly by placing the slide in the turn-table, and using a sharp bradawl to cut the balsam. A good margin of balsam must be left round the edge of the cover. The slide must be first varnished with balsam, but it may be finished according to individual fancy.

If the object be too thick for any bits of cover-glass, I generally use a slip with a countersunk cell. Nothing is easier than to mount with these. I should use them almost always, if they were not twice the price of smooth-edged slips.

I will now speak of the process for preparing insects for mounting. It is on the proper carrying out of these that the worth and beauty of one's slides depends.

To prepare an insect for being mounted in glycerine. First process: Simply soak it for a week in glycerine. Second process [to be used if the insect be curled up]: soak it for a day or two in acetic acid, then for half a day in distilled water; this makes the legs spread out. Soak in weak glycerine; then in stronger, and finally in pure glycerine, then mount it. Third process: For this refer to the first process for Canada balsam. Insects are prepared for glycerine jelly in the same way as for glycerine; for carbolated water they are prepared by simply soaking them in it for some time.

To prepare insects for balsam or dammar.—First process: After partial dissection, soak the specimens in liquor potassæ in the usual manner; when they are sufficiently transparent, complete the dissection, and boil them in clean liquor potassæ for ten seconds; wash them in distilled water, soak them for at least half an hour in acetic acid. [It does no injury to leave them in this for a week, but an hour or so is all that is needful . This gets rid of all potash. Wash them well in distilled water, and then in methylated spirit. [If they are to be mounted in glycerine instead of in balsam, they should be transferred to that medium without being put into spirits at all, but only well washed in water]. Soak them for a quarter of an hour in absolute alcohol, and then in oil of cloves for a short time. The oil of cloves is not absolutely necessary, but it is safer to employ it. Objects should not be left for more than a week in oil of cloves, since they are made hard and brittle by it. They may now be mounted in balsam or dammar, but it is better to wash them first in benzine, in which they may be kept for any length of time. Second process: For displaying muscles [applicable to naturally transparent objects only]. Soak for three or four days in ether, transfer at once to oil of cloves. Or, if the object be curled up, soak it in water to expand it, and transfer it to the oil by methylated spirits and alcohol, as described in the first process. Third process: For the same purpose and with the same limitations as process two. Soak for a very short time in potash; be very careful not to press the object at all, and proceed as in the first process, but without any boiling.

For soaking in potash I use half-drachm stoppered bottles; for acetic acid, straining fluids, etc., little glass pots, which I buy at Baker's for 2*d*. each. For boiling I use little porcelain evaporating dishes with handles, which I buy at Griffin & Sons', 22 Garrick Street, Covent Garden.—*Science Gossip.*

To be continued.

National Committee on Micrometry.

THIS committee, in the formation of which most of the active microscopical societies of the country have taken part, has been organized with the following officers and members: F. A. P. Barnard, LL. D., President of Columbia College, New York city, Chairman; R. H. Ward, M. D., Troy, N. Y., Secretary; George E. Fell, C. E., Buffalo, N. Y.; Henry Jameson, M. D., Indianapolis, Indiana; Prof. S. A. Lattimore, Rochester, N. Y.; Prof. Edward W. Morley, Hudson, Ohio; Joseph G. Richardson, M. D., Philadelphia, Pa.; Prof. Stephen P. Sharples, Boston, Mass.; Prof. H. L. Smith, Geneva, N. Y.; Prof. Albert H. Tuttle, Columbus, Ohio; J. J. Woodward, M. D., Washington, D. C.; Lester Curtis, M. D., Chicago, Ill.; the San Francisco society is represented on the committee, though not yet by a western man. The committee is already engaged in discussion of the large number of reports and letters that have been received on the subject.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

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The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

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Post-Office Box 2,852.

FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

Our New Offices.

WE write this in our new offices, at 14 Dey street, to which we have just moved. The new rooms are much more pleasant and convenient than our old offices, and when we get fairly settled we expect to remove many annoyances which cramped quarters entailed on us.

Our new offices are only a couple of doors from the main office of the Western Union Telegraph Company, and about two minutes walk from the General Post Office, so that our location is central, and as we are only a block or so from a depot of the Metropolitan Elevated Railroad, we are quite accessible.

It may not be out of place to say that from the same office are issued the YOUNG SCIENTIST, and the American Reprint of the LONDON LANCET.

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Microscopists at Work.

DR. H. R. HOPKINS, as President of the Buffalo General Local Committee to have charge of local matters with reference to the American Society of Microscopists, has appointed the following sub-committees to prepare the way for the annual convention which will be held in that city next August:

Committee on Finance—Dr. Thos. F. Rochester, Mr. Stephen M. Clement, Mr. Robert P. Wilson, D. W. C. Barrett and Dr. Lucien Howe.

Committee on Transportation—Mr. Jas. N. Scatcherd, Mr. James Tillinghast, Mr. John Allen, Jr., Mr. Henry H. Richmond and Mr. Spencer Clinton.

Committee on Accommodations and Rooms—Dr. C. C. Wyckoff, Mr. Geo. E. Fell, Dr. A. R. Wright, Prof. Ray T. Spencer and Dr. Leon W. Harvey.

Committee on Entertainments—Capt. E. P. Dorr, Rev. L. Van Bokkelen, Hon. Geo. W. Clinton, Dr. G. C. Daboll, Mr. Josiah Jewett and Dr. F. P. Lewis.

Committee on Microscopical Soiree—The Executive Board of the Buffalo Microscopical Club, viz: Dr. N. R. Hopkins, Mr. Jas. W. Ward, Prof. D. S. Kellicott, Mr. Henry Mills and Mr. Geo. E. Fell.

The Committee on Accommodations and Rooms have already held several meetings, and have decided that the Central School building be the place for the general assembly. This is the same building in which the American Association for the Advancement of Science met two years ago.

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Catalogue of Diatoms.

IT will gratify many of our readers to learn that a French edition of the "Catalogue of Diatoms," by Mr. Fred. Habirshaw, of this city, is to be issued by the publishers of the *Journal de Micrographie*, under the care of Dr. Pelletan, whose reputation gives assurance of the excellence of the edition. Of the first edition (American) there were only fifty copies issued. These were produced by the electric pen by Mr. Habirshaw himself, and privately distributed. Those who were so fortunate as to secure a copy of this valuable work prize it very highly, and the only thing to be regretted was the limited number issued. The new edition will remove this difficulty, and place the work within the reach of all students of this department of natural history.

Mr. Kitton has kindly taken the burden of revising the proofs of the new edition, which will be improved and enlarged, and we trust that diatomists in this country will give it their cordial and substantial support. The enterprise is not a very promising one, financially speaking, and Dr. Pelletan deserves the gratitude of scientific men for undertaking the venture.

BOOK NOTICES.

The United States Official Postal Guide. Boston: Houghton, Osgood & Co.

The number for April contains, in addition to the usual information, the new Classification Bill, approved March 3, which makes so many important changes in rates and details that every business man, and every person who uses the mails to any considerable extent, needs this authentic statement of the law. The price for a single number (50 cents) or for a year ($1.50) is little compared with the trouble and uncertainty avoided by having the Postal Guide.

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TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—The regular conversazione meeting of this society was held at their rooms on the evening of March 21, 1879, the president, Mr. J. D. Hyatt, in the chair.

Donations received: from Mr. Hyatt, slide of "Meridion circulare," many perfect circles of these diatoms, procured from West Point N. Y., and just mounted by him. Also from Fred. Habirshaw, Esq., a set of about three dozen Spongidæ, illustrating papers of H. J. Carter, in Annals and Magazine of Natural History, 187[illegible]-78, mounted by A. C. Cole from the original material. Of these there are but two other sets in existence, one in the British Museum, and the other is owned by J. Higgins, Liverpool. At the conversazione, after the regular business, was exhibited among other objects, by Mr. Hyatt, water from West Point containing living diatoms, chiefly Meridion circulare—also by the Recording Secretary, by means of polarized light, the curious and magnificent larva, (from his aquaria), "Corethra Plumicornis."

The regular meeting of the New York Microscopical Society was held April 4, 1879, President Hyatt presiding.

Donations: By Mr. Van Brunt, two slides of edible truffles, found by Mr. W. R. Gerard on Staten Island; by Mr. C. S. Shultz, the Secretary, a slide of so-called "edible earth," from Japan, composed, however, principally of diatoms, many of beautiful forms. After some routine business was transacted, the meeting adjourned.

The regular meeting of the New York Microscopical Society was held April 18, 1879, Chairman Hyatt presiding.

The principal business was selecting new quarters. It was decided that the society rent the two commodious rooms belonging to the Sunday School of "All Souls Church," No. 239 Fourth Avenue, near 19th Street, where they will be pleased to meet friends and co-workers on the first and third Friday evenings of each month (except vacation in July and August) during the next year. Some curious and interesting entomological objects, together with other general slides were shown, after which the meeting adjourned.

The regular meeting of the New York Microscopical Society was held May. 2, 1879, at the Society's new rooms, 239 Fourth avenue.

Dr. Hull, of Coeymans, N. Y., an active microscopist, was present as a visitor.

The Committee on Excursions made their final report of places to visit for the season, which are as follows: May 3—Hyatt's Ditch, Fordham, N. Y.; May 17—Fairview, N. J.; May 30—Pelham Bridge, Bartow Station, Harlem River Branch of N. Y. & N. H. R. R.; June 7—New Dorp, Staten Island; June 21—Fort Morris, fresh water ponds; July 5—Weehawken Ferry, New Jersey side; July 19—Harlem Kills, for salt water dredging; Aug. 2—Rockaway, Jamaica Bay; Aug. 16—Glen Cove, L. I.; Aug. 30—East Newark, fresh and brackish water; Sept. 6—Harlem Bridge, for ponds in neighborhood. Any further particulars will be furnished by the Recording Secretary, on application.

Prof. Arthur C. Elliott, of Peekskill, N. Y., was elected an associate member.

An invitation to attend the annual reception of the Westchester (Pa.) Philosophical Society was received with thanks.

Mr. Wall exhibited spores of the Esquisetum, or "horse tail," showing the curious and instantaneous effect of moisture upon them, in the divergence of their spirals.

A variety of algæ and diatoms were shown, from "Hyatt's Ditch," by Mr. Hitchcock, and numerous objects by other members.

A letter from the Royal Microscopical Society, of London, was received, announcing that our Society had the honor conferred upon them, of making our Presidents, while in office, a "Fellow," *ex officio*, of their society.

This communication was received with thanks, and the Corresponding Secretary requested to acknowledge the favor.

Chas. S. Shultz, Recording Secretary.

Rochester (N. Y.) Microscopical Society.—The Rochester Microscopical Society met at the Free Academy, April 14, President Lattimore in the chair.

The "stated paper" was read by the Rev. Myron Adams, his subject being "The Structure of Insects." The paper was very fully illustrated by means of plain and colored drawings.

Mr. Matthews reported the purchase of two revolving tables, of Mr. Fell, of Buffalo—a plain table at $5.50, and one with drawers at $10. These tables were thoroughly examined by members, and found well made and nicely finished. Since these were purchased, Mr. Fell has added a lock or clamp whereby the top may be fastened in any desired position. Prof. Kellicott, who was present at this meeting, spoke of the lock or clamp as a valuable addition to the working qualities of the table.

Nine gentlemen were nominated for active membership, and on ballot all were elected.

Drs. E. M. Moore, of Rochester, and Geo E. Blackham, of Dunkirk, were elected honorary members.

Prof. Chas. Forbes was appointed by the President to address the society at its next meeting (May 12), and Messrs. Dransfield, McGuire and Darrow, to furnish microscopes.

The President called attention to a micrometer made by Prof. Rogers, of Harvard; also to a turntable (a combination of Cox and Zentmayer's) made by a firm of this city.

The exhibit was as follows: Rogers micrometer, by Mr. Osgood; photo-micrographs, by Mr. Adams and Mr. Blivin; mounts of seeds, by Mr. Brownell, of Lyons; Cyclops quadricornis, and parallel ruler turn-table, by Dr. French; diatoms and other objects, by Mr. Rebasz and Dr. Morgan.

Buffalo Microscopical Club.—At the regular meeting of the club held at the Grosvenor Library, April 7, Prof. D. C. Kellicott read a paper on blood crystals, with comparative illustrations of the different forms peculiar to hæmoglobin, and hæmatin; showing apparent inaccuracies in existing drawings of these peculiar crystals, as found in previous treatises on the subject.

Prof. A. H. Chester of Hamilton College, exhibited some beautiful crystalizations of gold, silver, and copper, natural and artificial; the latter of his own preparation by several distinct processes, all of which were much admired for their novelty and beauty.

An interesting and well-attended meeting of this club was held on the evening of May 13, at the same place. Mr. G. E. Fell read a paper, detailing with great clearness his method of mounting opaque objects in cells of wax, enclosed in metallic rings, illustrated by numerous slides showing their appearance at different stages of the process.

Dr. Lucien Howe read some notes of a paper to be given more clearly hearafter, on the eyes of the spider, and insects in general. The question was physiologically treated, with reference, comparatively, to the eyes of both lower and higher forms of animals, showing relation, progress and degrees of development in adaptation and perfectibility.

Mr. Oakley, of the House of Blevin & Oakley, photographers, exhibited specimens of their work, in the form of micro-stereographs of several very clearly defined objects.

James W. Ward, Secretary.

New Jersey Microscopical Society.—This Society met at Rutgers College, New Brunswick, on the 21st of April. Two new members were elected. It was determined that the annual meeting of the 26th of May, should be open to the public, and Dr. H. B. Baldwin was requested to read a paper on the "Service of the Microscope in Medical Science," and the secretary to give a paper on *Palmella cruente*, the "Bloody Dew" of Europe, he having collected this Algæ recently in England. The Secretary exhibited a piece of stout foolscap writing paper. The original size was three inches by two inches, but it was nearly eaten up. This was done by a pair of flies which had just come out of their hibernation. The specimen was interesting as showing the solvent, and sucking powers of the insect. In some spots where the paper had been softened by the secretions of the insect, there were little teat-like prominences where the pulp had been drawn up, and so to speak molded by the suctorial proboscis. In no case was the fibre bitten, but softened, and drawn up; and around the holes so made in the paper, was a tiny wave or curl showing that the suctorial organ was pressed with considerable force against the edge, thus pushing the softened edge, so as to curl away from the hole. This curling in every instance was upward and on the side occupied by the fly while eating. Though much larger than the ordinary domestic fly, this insect, like the other, hibernates in our houses; and it must now be admitted that some of the mischief done to books and papers, which has been charged to the neuropterous insect, *Lepisma sacharina* stands chargeable to this dipterous fly, and perhaps to other members of this order. The secretary exhibited the large feathery antenna of *Anopheles*, the large spring mosquito. A slide with a thin section of *ligmile* from California, prepared by Dr. A. C. Stokes, was said by the secretary to be from coniferous wood, the "pitted cells" being very distinct. Dr. Baldwin showed diatoms which he had obtained from the sea beach at Barnegat. A slide prepared by the secretary from a drop of the contents of the clam, *Mya arenaria*, obtained at Manasquan, N. J., showed that the food of this mollusc was mainly composed of diatoms. It seemed that in one stomach there might be a million individuals. After appointing the neces- committees to arrange for the annual meeting, the society adjourned.

S. Lockwood, Secretary.

State Microscopical Society of Illinois.—The regular meeting of this Society was held at the Academy of Sciences, March 28, President Fuller in the chair.

After the transaction of routine business, Dr. Lester Curtis read a paper on the "Tactile Hairs of Certain Animals," which may be summarized as follows:

The first noticeable peculiarity of the tactile hair, as in the snout of a mouse, is the great size of the follicle, several times the diameter of an ordinary hair follicle. This follicle has a bulging about one-third of the distance from the top, which corresponds with a remarkable enlargement within.

Two-thirds of the lower portion of the follicle is surrounded by striated muscular fibre, which appears to arise from the side of the follicle by a short tendon encircling it, and these pass off to a considerable distance, to become lost in the muscular fibres of the lip. These muscles are furnished with a rich plexus of unusually large capillaries. Other muscles are attached to the hair in a manner somewhat similar to the ordinary erectors of the hair, but are more abundant, and of the striated variety.

Within the follicle and outside the root sheath of the hair, is a close plexus of very fine capillaries, which send branches over the enlargement mentioned above, and form a peculiar ring-like plexus above it. Between the branches of this ring-like plexus there is but little tissue, but in the mouse and cat, at least, it does not form a sinus, as is claimed by some.

The enlargement surrounds the hair eccentrically, and consists of two parts, the outer of which, when the follicle is divided longitudinally through the centre of the hair, is nearly circular in outline, and is attached to the inner part by a short, thick pedicle. It is interspersed with oblong nuclei. The inner part is not as wide, but is longer, and surrounds the root sheath like a band.

The speaker considered these last structures to be of a nature similar to the terminal organs of nerves found in other portions of the body, but was not prepared at present to prove his position.

The paper closed with a brief bibliography of the subject, after which numerous slides illustrating the structures discussed were exhibited.

Adjourned.

The annual meeting of the State Microscopical Society of Illinois was held at the Academy of Sciences, April 25.

The address of the President occupied that portion of the evening usually devoted to the reading of papers, and consisted of a review of important microscopical work during the last year, and of improvements in microscopes and accessories; also a review of the work of the Society during the same period, and recommendations as to work during the coming year.

The Society then proceeded to the election of officers, as follows:

President—Prof. H. A. Johnson.

Vice-Presidents—H. H. Babcock and Lester Curtis.

Treasurer—W. H. Summers.

Recording Secretary—E. B. Stuart.

Corresponding Secretary—Prof. William T. Belfield, M. D.

Trustees—H. W. Fuller, Jas. Colgrove, Prof. E. G. Bastin, B. W. Thomas, H. F. Atwood.

The Society then passed a vote of thanks to Mr. Fuller, for his long-continued and faithful efforts in its interests during his presidency (a period of eight years).

President Johnson and Messrs. Babcock, Curtis, Fuller and Stuart, were elected a standing committee on micrometry, with power to appoint a delegate to the National Committee.

Adjourned to fourth Friday in May.

ERNST B. STUART, Secretary.

Dissecting Microscopes.—At a meeting of the Quekett Microscopical Club, held Nov. 22, 1878, the following interesting discussion was held on this subject, Prof. Huxley, F. R. S., President, in the chair:

The President said that the subject which he wished to bring before them that evening was a sort of contrivance which he had recently adopted himself, for the purpose of making dissections. They would all be aware that in a microscope to be used for delicate dissections, certain qualifications were absolutely essential. In the first place they must have perfect steadiness, the stand must be firmly and well supported, and be of sufficient strength and weight to bear the pressure put upon it without moving. Next it must be of convenient height, so that in working, the hands might get a steady support; it should fulfil these two conditions, and yet not be so large as to be clumsy. The next point was as to the lenses; they should be of such a form as to give a maximum of power, and yet at the same time afford sufficient distance between them and the object to admit of needles being moved freely to an angle of 60° with the surface of the plate, because the efficiency of the needles obviously depended upon the angle at which they could be used, and if a lens were made with a wide face it would very often interfere with the movements of the needles. Then there was another point of still greater importance: When a careful dissection had been made it often became desirable to examine it with a much higher power than the one which had served the purpose of preparation, and provision ought to be made to enable as high a power as was desired to be brought to bear without disturbing the object, and this could only be done by placing a compound body above the simple lens. The President then exhibited the instrument which he had devised to meet these requirements, and pointed out that it consisted of a glass stage, having a large aperture in the centre, and mounted horizontally upon three supports, one of which was formed by the pillar of the body; in this way it stood with great steadiness, and was strong enough to bear considerable pressure. The lens was carried by an arm projecting from the pillar, and made to turn aside horizontally when required; focussing and illumination were managed in the usual way, but there was a slow motion in addition to the rack-work. In offering the instrument for discussion, the question would arise as to the best form of lens to be employed, and he hoped to receive the opinions of the members upon this and other matters; but at present he used an ordinary low-power achromatic objective made so as to slip into the arm without screwing; there was great convenience in thus mounting and using a simple lens. With the old doublet there was much difficulty in working comfortably, and whether a person could do so or not depended a good deal upon his nose, being specially troublesome in the case of those persons who had somewhat aspiring noses. In addition to the lens which he had placed upon the instrument, there was another belonging to it of half the focal length. Now, supposing they had made their dissection successfully, the point was how to be able to convert the instrument at once into a compound microscope without disturbing either the lens or the object. One of his aims in life had been to get microscope makers to abolish screws, which he regarded altogether as abominable inventions, and in this instance, the compound body had been made to slip over the outside of the socket in which the objective had been placed. This plan answered fairly well, but he thought it would be better to have it made to fit rather more easily, and to be secured by a bayonet joint, because, supposing that the power employed was not sufficient for the purpose, then inconvenience arose unless the body could be got off again with sufficient ease to ensure the object remaining undisturbed by any jerk or movement. With the improvement of the bayonet joint, it would be easy to remove the body, and having taken out the first lens and dropped in, say a one-eighth inch, the body would go on again without any disturbance. He had the instrument before them made upon that pattern, to see how the thing would work; he had used it for the past six or eight months incessantly, and could certainly say that for his requirements it was the best thing he had seen, and he believed that with the little addition of a bayonet joint it would be as nearly perfect as any instrument of the kind could well be. He thought that all persons who had been occupied in making minute dissections would see that it had value, and met all the requirements of the most delicate work. He hoped that the members would examine and criticize it, and make any suggestions that occurred to them for its further improvement, for it was becoming of very great importance to examine thin sections and minute portions of dissections without subjecting them to any such disturbance as to cause the slightest alteration, and it was equally important to be able to bring to bear upon them under such conditions the highest powers that might be needed.

Dr. Matthews inquired if the President spoke of dissecting in water?

The President said that he referred to dissection in a very shallow trough, and by transmitted light.

Dr. Matthews inquired if the President had ever employed a binocular eye-piece for dissecting purposes?

The President said he must confess that he was rather heretical as to binoculars in such cases. What was really wanted was to have the object well lighted and well defined. For all ordinary purposes there was nothing better than a good watchmaker's eye-glass, because it was so readily adjusted to the work, and, with a good orbicularis, to keep it in place, there was no trouble in using it.

Dr. Mathews explained that he meant the ordinary binocular eye-piece, and not the binocular microscope. Some persons had a difficulty in holding an eye-glass properly, and to meet such cases there was another plan for using a single lens, namely mounting it upon an elastic wire, which could be moved to or from the object as required, by the pressure of the head.

The President said that there was sometimes a little difficulty about holding the glass in the eye at first. When a person was beginning to do so, he was apt to indulge in a good deal of impatient ejaculation; because, when he got absorbed in his work, he forgot the eye-glass, and let it drop occasionally into the middle of his dissection.

Mr. Ingpen thought that a large spot lens would be found of value, so as to get a black ground for the illumination of delicate transparent tissues in water, especially as it would not exhibit the disturbance of the surface of the water by the needles.

The President said that he generally used a black screen for latter purpose. There was one other point upon which he should like to have the opinion of the club, and that was upon the best way of illuminating things whilst working by daylight. He could not get on very well with the condensing lens, and found it rather troublesome; reflected light seemed to be the best, and he had often wondered if a polished hollow cone would be a good sort of thing to use.

Dr. Matthews said that the idea had occurred to him of adapting something like the "*speculum uteri*" to the purpose, which would resemble a Wenham's illuminator inverted. He thought it would answer very well with a lens inserted into the wide end; he was, in fact on the point of having one made, to try.

Mr. Charles Stewart was sorry to say that he must differ somewhat from their President as to the value of the binocular microscope in dissecting, for he had found it of the greatest use in the case of transparent objects, since it enabled him to recognize the precise position of one object above or below another, with a facility which he thought was of the greatest importance. He also wished to bring before them a little matter which he thought might be of interest, as it was in some degree connected with the subject which had engaged their attention. In making minute insect dissections, he had often found the want of a perfectly structureless background upon which to pin the object, and upon which it might be treated with spirit, and set aside to work upon at leisure. He had tried various things, but at length Mr. Field, of the Ozokerit Works, gave him a small quantity of black Ozokerit (or black wax as they called it), and this seemed to answer admirably, for it melted at a low temperature, remained soft enough to stick a pin into, and was absolutely unacted upon by strong alcohol, or water, or by any mixture of them. When required for use it was only necessary to put a few knobs of it in a saucer, and when it was warmed it flattened out over the bottom with as smooth a surface as could be desired. There were two sorts of it, one being a little harder than the other—he had brought some specimens of each with him to the meeting, both in the lump and run out in small saucers; the rims of these little saucers being ground off flat, a glass cover could be laid over them, and the contents would be preserved from dust, and, in a great measure, from evaporation also. One very great advantage about this stuff was, that there was no stain to come out of it; if gutta percha was used, the spirit extracted a kind of gummy product from it, a stain came out of it, and it very soon became brittle, whilst even the best cork contained numerous small cells, which got out after a time, and seemed to have a peculiar proclivity for attaching themselves to the most delicate nerves and filaments. The new substance seemed to him to fill a want, and it was equally useful for large dissections, as it could be made to line a trough with very little trouble.

EXCHANGES.

Wanted to exchange, good slides (French mounting) for condensing lens on stand, or standard size slides of vegetable preparations. C. R. Barnes. Madison, Ind.

Wanted, a No. 3 eye-piece, 2-inch objective, or polariscope, in exchange for various well-mounted objects. John Walker, 810 12th avenue, S. Minneapolis, Minn.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

VOL. IV. NEW YORK, JUNE, 1879. No. 6.

Organisms in the Blood, and the Germ Theory.*

WE have here in a small illustrated work an able critical *resume* of some of the most important facts previously known on the subject, together with others not hitherto published, tending not only to increase our knowledge, but also to throw light upon the general question of the relations of the microscopic organisms found in the blood to disease.

Nearly two-thirds of the work refers to the existence in the blood of vegetal organisms of the type of bacteria, bacillus, and their allies, while the remaining third relates to the existence in this situation of animal organisms. We have in this latter part a brief but interesting history of what is known concerning the existence of nematoid hematozoa in the lower animals, and also of what has been learned concerning the embryos of the *Filaria sanguinis hominis*, first discovered by the author in 1872, in the blood of persons suffering from Chyluria.

It seems evident from the account here given that we have still almost everything to learn as to the source and parental forms of these embryo nematoids found in the blood of man. The hypothesis of Manson concerning the part played by mosquitos as intermediate hosts (within which some of the embryos swallowed may undergo development, and from the bodies of which parent forms, capable of infecting man, may find their way into drinking water) seems, from the careful observations made by Lewis, to be rendered more than doubtful. The relations of these organisms to the morbid conditions with which they are associated are, indeed, full of the most puzzling difficulties. It is somewhat doubtful whether the mature form of this helminth has yet been discovered, notwithstanding the observations of Dr. Bancroft in Australia, and of Dr. Lewis himself (as referred to on pp. 85–89). The fact of the persistence of the envelope of the ovum as a diaphanous sheath, surrounding each of the young embryos found in the blood of man, would seem to the writer strongly to suggest the probability that the embryos in question have been liberated at once into some portion of the vascular system, rather than that they have entered it from without by penetrating its walls. If such a process of struggling

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***The Microscopic Organisms found in the Blood of Man and Animals, and their Relations to Disease.* By Timothy Richards Lewis, M.B., Army Medical Department, Special Assistant to the Sanitary Commissioner with the Government of India. (Calcutta, 1879.)

through tissues were to take place, their thin diaphanous envelopes would stand a good chance of being torn and left behind.

Nematoid helminths have long been known to occur in the blood of many birds, and Dr. Lewis says: "I have examined a considerable number of the ordinary Indian crow (*Corvus splendens*), and have found that the blood of nearly half of those which have come under my notice have contained embryo hæmatozoa of this character. Sometimes they are in such numbers as to make it a matter of surprise how it is possible that any animal can survive with so many thousands of such active organisms distributed throughout every tissue of its body. The birds did not appear to be affected in the slightest degree by their presence. In their movements they are very similar to the nematoid embryos found in man; they are, however, considerably smaller, and manifest no trace of an enveloping sheath."

Again, observations made many years ago by MM. Gruby and Delafond went to show that 4 to 5 per cent of the dogs in France harbored microscopic nematodes in their blood; Lewis ascertained in 1874 that more than a third of the pariah dogs of India are similarly affected, whilst Dr. P. Manson has shown that this kind of parasitism affects at least an equal proportion of dogs in China. The embryo nematodes belonging to dogs of these different countries seem to agree with one another in all their characters. It is important to note that their presence is not associated with the existence of any definite disease. The dogs harboring such parasites are outwardly indistinguishable from others which have them not. Strange as this may seem, it is also strange that the mode in which the embryo organisms gain access to the blood is still involved in great obscurity. It is true that, by several observers at different times, thread-like mature nematodes (*Filaria immitis*) have been found in more or less abundance in the right chambers of the heart of the dog. These have been found to be extremely common by Dr. Manson in China, and might therefore naturally enough be considered as the source of the multitudes of embryo nematodes found in the blood of these animals. But if true for China, it ought also to hold good for India; yet Dr. Lewis says: "It seems somewhat strange that, notwithstanding the marked prevalence of embryo hæmatozoa, the *Filaria immitis* has not, so far as I can learn, been recognized in India. I have often searched specially for it but in vain. The only mature parasite which appears to affect the circulatory system of dogs in this country is the *Filaria sanguinolenta*, a description of which, together with an account of the pathological changes which are caused by it during its development in the walls of the aorta and adjacent tissues, was published by me in 1874."* But then, the same writer adds: "Notwithstanding the circumstance that this is the only mature helminth which I have found associated with the embryo hæmatozoa of India, I cannot believe that there is a genetic connection between them, for it frequently happens that the mature worm may be present in abundance unassociated with blood embryos of any kind, and sometimes it is found that the latter exist without any trace of the former."

What has been said above suffices to show the very considerable gaps in our knowledge concerning the life-history of the nematoid hæmatozoa of man and animals, and also the tendency so frequently met with among some observers to bridge these gaps by unsatisfactory explanations deduced from a too-narrow survey of the facts—a perennial source of error peculiarly common in regard to this class of questions.

Of the protozoa referred to as being found in the blood of the lower animals, the newest and perhaps the most interesting are those now first described by the author as existing in that of rats. Being directed by the Indian Government to make observations on the spirillum occurring in the blood of patients suffering from the Bombay fever, the author says: "Whilst doing this I had occasion to examine the blood of a considerable number of animals, and eventually (July, 1877) detected organisms in the blood of a rat which, at first sight, I took to be of the nature of vibrions or spirilla." The organisms, of which figures and photographs are given, are each of them provided with a long and very distinct flagellum, though otherwise they are not very different in appearance from some bacilli. Subsequent observations showed Dr. Lewis that whilst such organisms do not seem to exist in the blood of mice, they are to be found in two species of rats, viz., *Mus decumanus* and *Mus rufescens.* Concerning their prevalence and pathological significance in these animals, he says:—"I have examined the blood of a great number of rats for the purpose of ascertaining what proportion of them contains these organisms in their blood, and find that of those specially examined for this purpose, their existence was demonstrated in 29 per cent. Sometimes, however, the numbers detected were very few, not more than one or two in a slide, but in the greater number of cases they were very numerous, every slide containing several hundreds. . . . With regard to the health of the rats in which these flagellated organisms were detected, there was nothing to suggest in any way that they were less healthy than others not so affected, and I have repeatedly kept rats for a considerable time for the purpose of observing whether any special symptoms would be manifested. . . . When it is considered that thousands of active beings of this character can exist in the blood without in any appreciable manner affecting the health of their host; and when it is further considered that these organisms must consume at least as much, if not far more, oxygen than bacteria, bacilli, and spirilla, it becomes difficult to understand how it comes about that, to a like action on the part of the latter is ascribed the asphyxia and the other morbid conditions which characterize death from splenic disease and allied affections." Such a view has been put forward by MM. Pasteur and Joubert, though it is well known, and has been pointed out by Virchow amongst others, that the proportion of bacilli in the blood at autopsies bears no sort of relation to the severity of the disease previously existing in the persons under examination •

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*The Pathological significance of Nematode Hæmatozoa.

But it is in regard to these vegetal organisms existing in the blood of man and some animals that the larger part of Dr Lewis's memoir refers. He evidently entertains a clear view of the principal phenomena to be considered in reference to this part of the subject, and exhibits a rare absence of a tendency, which is unfortunately but too common, to slur over fundamental difficulties standing in the way of the acceptance of the "Germ Theory of Disease"—or the "Doctrine of Contagium Vivum," as it is sometimes termed. In addition to acute criticism, Dr Lewis has made known some very significant and important new facts.

After referring to the generally received view that organisms of the bacterium or bacillus type do not exist to any recognizable extent in the blood of healthy animals, and to the experiments made some years ago by Dr. Douglas Cunningham and himself, which showed how quickly, after such organisms had been purposely introduced into the blood of healthy animals, they disappeared therefrom, he says:—"It may be safely affirmed that their presence in appreciable numbers is, judging from experience, incompatible with a state of perfect health." The case in regard to these microphytes is, therefore, different from what has been stated to obtain with the animal organisms before mentioned, which may swarm in the blood of creatures who are in other respects quite healthy.

One or other of such microphytes has been found to be generally present in *charbon* or *splenic fever*, and in *recurrent fever*. M. Pasteur has of late maintained that *septicæmia* is also characterized by the existence of such organisms in the blood during life; and to this list Dr. Klein adds the so-called *typhoid fever* of the pig.

It is impossible to follow the author through his discussion (pp. 11-34) of the leading facts regarding the connection of microphytes with the disease above mentioned, but we may briefly consider the question of their causal relation to the morbid conditions with which they are severally associated.

If the organisms of this type commonly met with outside the organism are not specifically injurious when introduced into the bodies of higher animals (and this has been abundantly proved and is commonly admitted), then, the notion that those met with in certain diseases are causes thereof, must necessarily be associated with the belief that they are organisms in some way distinct from the common forms. And this is generally the case; as Dr. Lewis says:—"All the advocates of the germ theory, with very few exceptions, maintaining that the particular organism, in the particular disease in which they are specially interested is wholly distinct from all others.

This is a position which is far from having been proved, however, and is by itself an extremely questionable doctrine. There are no real morphological characters separating the bacillus of splenic fever or of "pig typhoid" from the bacillus of hay, of urine, and of multitudes of other organic mixtures. So far as morphological characters are concerned, this is practically admitted; but then it is contended by Cohn and others that difference in "physiological property" may afford sufficient ground for the establishment of specific distinctions, even in the face of morphological similarity. This is a rather hazardous doctrine, and requires to be advanced with the greatest caution. To what extent in the vegetal and in the animal scale is it to hold good; or is it to be a distinctive character confined to the most protean and highly modifiable of all organisms? On the one hand we find such an authority as Prof. Cohn of Breslau supporting the notion: on the other a scarcely less weighty authority, Prof Nageli of Munich, declaring that he is unacquainted with any facts really supporting such a view. He says: "I have during the last ten years examined some thousands of different forms of fisson-yeast cells,* but (excluding *Sarcinæ*) I could not assert that there was any necessity to separate them into even two specific kinds."

Bacilli, born and bred in the midst of the blood and tissues of a diseased animal, might have certain slight molecular differences impressed upon them, by reason of which they may tend during their nutritive life-processes to secrete a poisonous chemical principle—just as the common putrefactive bacteria are known to do—and it may thus happen that the progeny of such organic units born in morbid fluids or tissues, are capable of setting up morbid processes in the animal economy such as do not follow from the addition to it of bacilli nurtured in a bland hay infusion. This is a mere surmise, thrown out as a view which may be found by some to be easier of acceptance provisionally then the notion that, among the most variable of organisms, from a morphological point of view, several "species" present themselves under precisely the same form, and that identity or difference of "species" is to be judged by the mere effects produced by their invisible molecular activities.

Further, it should be borne in mind that the association between the organisms and the diseases in question is not absolutely constant, nor is the severity of the disease in the least proportionate to the abundance of the organisms found in the animals affected. Speaking of recurrent fever, Dr Lewis says: "Whereas spirilla could generally be detected in cases of fever of this kind, nevertheless cases every now and then occurred in which perfectly competent observers failed to detect them in the blood from first to last, and this too in cases not a whit less severe than those in which the organisms abounded, and which were under the care of the same observers during the same period." This was the experience of Dr. Lewis himself.

Again, in regard to the same disease, the assumed cause will not operate when it is placed under the most favorable conditions—conditions in which it is scarcely conceivable that the organisms should fail to operate were they the veritable causes of the disease. Alluding to well known experiments made by Obermier, the discoverer of the spirilla of recurrent fever, our author says:—"The inoculative experiments which he undertook, consisting of the injection of spirillum-blood of fever patients into the veins of dogs, rabbits, and guinea-pigs, proved abortive, nor was there any effect produced by the injection by means of a subcutaneous syringe of small quantities of such blood into the bodies of healthy persons." Others likewise failed to reproduce the disease by similar means, though one observer states that he had been more successful in thus setting up the disease—irrespective, however, as he says, of the presence of spirilla in the blood with which inoculation was made.*

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* That is, the *Schizomycetes*, in contradistinction to the true yeast cells.

What manner of cause then is this, whose effects take place in its absence, in no corresponding ratio when present, or whose presence is followed by no effect at all? One of a strange order, truly!

But now we come to a great difficulty, an all important matter, which in its turn has to be explained by those who cannot accept the notion that the microphytes to which we have been referring are causes of the diseases in question. Those who hold the opposite notion will naturally say to the opponents of the germ theory—But, if these organisms are not to be regarded as causes of the disease how do you account for their very frequent presence in association therewith?

Communicable or contagious diseases constitute a large class, and those in association with which microphytes have been found form only a small minority. Seeing the multitudes of observers who have been searching for them for years past in the blood of persons suffering from such affections as scarlet fever, small-pox, measles, and others, the chances that any such organisms will be found in association with these diseases may be said to be diminished to a minimum. Therefore, in so far as concerns the very frequent occurrence of organisms in the blood of persons suffering from recurrent fever, splenic fever, and some other maladies, it would be perfectly consistent (if conformable with other evidence) to regard such organisms as quasi-accidental products or epiphenomena of the diseases in question.

If we accept the doctrine of Pasteur, Lister, and others to the effect that the blood of all healthy animals is invariably free from such microphytes, the appearance of organisms in the blood as epiphenomena in the course of certain diseases can scarcely be explained except by the supposition that archebiosis or heterogenesis (one or both) have taken place in their altered blood, or in blood and tissues simultaneously.

This the present writer long ago pointed out, and he strongly insisted upon it in a paper published about eighteen months ago,* but which does not seem to have reached Dr. Lewis before the printing of his present work. Attention was there specially called to the fact that organisms speedily appeared in the blood of previously healthy animals or of human beings suddenly killed, in such situations and under such conditions as to make it almost impossible to account for their presence except by the occurrence of one or other of the processes above mentioned, giving rise *in situ* to a new birth of such microphytes. Organisms can, in fact, be made to appear at will (as Lewis and Cunningham, as well as Sanderson, had shown) in localised parts of previously healthy organisms by lowering the nutrition in certain ways of such parts of the body, *i. e.*, by either tying the artery supplying the part with nutrient fluid, or by subjecting the part to the influence of some germless chemical irritant. On the other hand, when the nutrient processes throughout the body are checked by the death of the animal, the production of microphytes, which was before local, now, as the writer has several times pointed out, becomes general.

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* The relations of this spirillum to other known spirilla is discussed at pp. 46-48.

*"On the Conditions Favoring Fermentation, etc.," Journal of Linnean Society, (Zool.,) vol. xiv. pp. 89-93.

Let the germ-theorists look to these facts and give us a better explanation if they can; because in the cases above referred to, organisms appear in tissues which they themselves have proclaimed to be germless, and in blood which they have declared to be free from all antecedent signs of microphytes.

The facts of the latter order have been distinctly confirmed by Dr. Lewis. He says: "Rats were obtained, killed by means of chloroform, and set aside from three to twenty-four hours or longer, according as the temperature of the atmosphere was high or low. The result proved that almost invariably bacilli were to be found in the blood, in the spleen, and in other organs."

It appears, however, and the fact is one of considerable significance, that when death takes place in certain modes (as by poisoning with carbonic acid or carbonic oxide), organisms have a still greater tendency to appear in the blood, and that they manifest themselves with surprising rapidity.

A man who was sent to seek for rats, having found, "That he could procure more than could be accommodated in the cage he had brought with him, he obtained a large earthen vessel, transferred twenty-seven rats into it, and tied a piece of cloth over the month of the vessel. As may be supposed, the rats had perished before he got home—all except one. . . . I examined the blood and the spleen of twenty of these rats within about six to eight hours of their having been caught, and found in each case that there were innumerable bacilli present, in every way morphologically identical with *Bacillus anthracis*.* In some of the cases the number was astonishing. They were present chiefly in the form of rods, but here and there some were seen to have grown to such a length as to cover two fields of the microscope. . . This experience tends to give support to the statement made by M. Signol before the French Academy, to the effect that motionless bacilli identical with those found in charbon, will be found in sixteen hours, or less, after death, in the blood of animals which have been asphyxiated by means of a charcoal fire.

Dr. Lewis shows that these organisms which make their appearance within the bodies of animals so soon after death are not only morphologically indistinguishable from *Bacillus anthracis*, but that they go on, under suitable conditions, to the so-called "spore" formation in precisely the same manner. The characters of these organisms under different conditions are well shown in Pl. 1.

But if mere modes of dying influence the quickness with which such organisms appear in the body after death, it is not inconsistent to suppose that they may in certain cases—that is, in association with certain morbid processes—be much more prone than in others to show themselves as epi-phenomena. And this seems to correspond with what actually occurs; in many contagious diseases, as above stated, such organisms seem to be absent, in a few they show themselves, and that by far the most frequently in cases where death is already pretty closely at hand.

Referring to the bacilli met with in malignant pustule (charbon), septicæmia, and the so-called "typhoid fever," in the pig, horse, and other animals, Dr. Lewis says; "It may be confidently stated that they are never to be detected in the earlier stages of the disease, but only at a brief period before and after a fatal termination. To my knowledge they have never been found in the blood of animals which have subsequently recovered; they have always been recognized only as one of the concomitants of impending dissolution. This is undoubtedly the case so far as the two diseases first cited are concerned."

Those who are the warmest advocates of the germ-theory of disease—a doctrine resting on sufficiently unstable foundations—are not always cautious or discreet in the way they speak of others who lean to a belief that the organisms met with in association with disease are mere epi-phenomena, often produced within the body by a process of heterogenesis. Yet the latter interpretation, so far as present knowledge goes, seems to the writer essential for the explanation of our power to determine, at will, the presence of microphytes in the germless tissues or germless blood of previously healthy animals.

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*That is, the bacillus met with in association with charbon or splenic fever.

H. Charlton Bastian.

[*Nature.*

The Use of the Microscope in Pharmacy.

A Lecture delivered by E. B. Stuart, Esq., at a Pharmacal Meeting of the Chicago College of Pharmacy.

GENTLEMEN—I take pleasure in addressing you on the use of the microscope in pharmacy, in the hope of awakening an interest in the minds of some that will lead them to take up this useful and fascinating study for themselves.

It is a matter of regret that so few pharmacists make use of this instrument, and that its value in the shop is so little understood by them as a class. Our professional friends, the doctors, rightly regard it as invaluable in their practice, a single glance through the tube frequently affording means for a positive diagnosis of disease that could be gained in no other way.

Chemists are enabled by its use to distinguish precipitates, which are alike to the unaided eye; and botanists regard it as indispensable in their studies. In fact, our knowledge of the minute structure of plants, and, consequently, of the phenomena of vegetable life, is derived from the use of the microscope, and dates back only to the comparatively recent improvements of objectives by Mr. Lister, in the first half of the present century.*

When we consider that the art of pharmacy is based on the application of these two sciences, chemistry and botany, it seems a matter of surprise that the pharmacists should, as a class, be totally in ignorance of the art of microscopy.

To illustrate the uses to which the instrument may be put by the apothecary, I will suggest examples intended as illustrative. rather than exhaustive; in fact, the subject is not likely to be exhaustively treated for many years to come.

The microscopal characters by which drugs derived from the vegetable kingdom may be identified are various and partly as follows: Peculiar arrangements of cells into special organs or tissues, and peculiar cells and cell contents, such as stack, crystals and alkaloids, which are sometimes visible in thin slices of the part, or, if not occuring this way, may be separated by the action of suitable solvents or by heat.

Returning to cells: you are all aware that plants are built up entirely of these bodies, and that they consist essentially of an outer wall or members of cellulose, which may contain various liquids, semi-solid or solid matters, and that these cells vary greatly in size, shape or markings. The size of cells ordinarily is from one to two four-hundredths of an inch in diameter. The very largest among the bast cells of bark may be as long as one-thirtieth of an inch, while the smallest do not exceed one six-thousandth of an inch. If their growth is unobstructed, their shape is round or nearly so, and when closely packed by the growth of the plant they assume various forms. When the cells are in this way pressed into cubical shape, the tissue is said to be regular; when they are elongated, prismatic; tabular when flattened, and muriform when breaking joints, like bricks in a wall.

The markings of cells may appear as dots, in which case they are termed dotted cells; or as bars or little slits, when they are called fenestrated cells; or as bands, rings or spiral markings, forming what are called reticulated, annular or spiral cells. These variously marked cells are so minute that in the operations of powdering a sufficient number will escape mutilation to enable the microscopist to detect their presence. It is, however, far easier for the microscopist to identify a powdered drug by means of its starch granules than by its cell structure. These are found sometimes in leaves, but more usually in the root, rhizome or seed, stored up by nature to supply nutriment to the young plant of the succeeding generation, until such a period of its growth as it can put forth leaves, and by their agency provide material for its own growth.

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*Referring to the correction of spherical and chromatic observation by lenses of flint and crown glass. Published 1829.

The features presented by starches are size, which varies greatly, but has a pretty constant average for each kind; shape, which is quite characteristic; and the position of the hilum, which appears as a dark spot in some constant situation on the granule, and thereby serves to distinguish granules closely resembling each other in other respects, as between potato and arrowroot starches—in the former it is on the small and the latter on the large end of the grain.

The starch of canna rhizome has the reputation of being the largest, and rice starch among the smallest known.

The curious crystals seen in the cells of plants may be composed of silica or oxalate, phosphate or carbonate of lime, and are conveniently referred to classes based on their different shapes, as follows: Raphides or needle-shaped, found in the balsaminaceæ, rubiaceæ, dioscoraceæ saxifragaceæ, melanthaceæ, and others; sphæraphides, in the caryopyllaceæ, rhamnaceæ, caprifoliaceæ, polygonaceæ, cactaceæ, etc; while long prisms are characteristic of the pericarps of the compositæ, orris leaves, guaiacum wood bark, soap tree bark, bulb scales of onion, garlic, leek; and lastly, short prisms in the leaves of leguminosæ, testa of the ulmi, and the pericarps of some compositæ. Silicous crystals are found in the cuticle of the grains and grasses, while it seems to make up most of the structure of the seeds and cacti.*

The examination of plant tissue with the microscope requires but few accessories, and in general but little manipulative skill. By cutting thin slices, with a sharp razor, in various directions, the different cells, ducts and fibres which make up the structure will be brought into view. Raphides may be brought out more plainly by maceration in turpentine, and mounting in balsam of fir. A polarizing prism is useful in their examination, as under the polarized ray the crystals stand out in brilliant colors against a dark ground.

Starches may be seen in the powdered drug or section, and can be easily separated by washing the powder with water on a muslin strainer. The grains wash through, and soon subside to the bottom of the vessel.

Very interesting and profitable studies of plant structure may be made by a process of double staining' based on the property of growing or "protoplasmic" material, absorbing certain dyes more readily than the cellulose or "formed" material, and *vice versa*.*

The use of reagents is sometimes advantageous, not only to demonstrate the presence of certain substances, but in some cases to dissolve them and bring others into view. For instance, in examining a section of some seed with the microscope, a very dilute solution of potassa will dissolve the albuminoid matter, leaving the starch grains plainly visible. surrounded by a net-work of delicate fibres. The application of iodine will now turn the starch grains blue, and the thread-like cell-walls of cellulin yellow, or a solution of iodine in zincic chloride, both blue.

Alkaloids may, in some instances, be separated from their natural combination by the use of appropriate solvents, and on the evaporation of the liquid left in characteristic crystals on the slide. It is, however, only when minute quantities of material are available that it becomes necessary or desirable for the pharmacist to resort to this expedient to identify a substance.

When visible quantities are at command, it will be found more satisfactory to separate proximate principles in a pure state, and use the microscope to identify crystals too small to be distinguished by the naked eye. Thus, among the cinchona alkaloids, quinia. quinidia, cinchonia and cinchonidia can be readily distinguished by the application of potassium sulphocyanide or by

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*Geo. Gulliver, *Monthly Microscopical Journal*, September, 1877.

*Geo. D. Beatty, *Science Gossip*, April, 1875, and May, 1876; (republished in AMERICAN JOURNAL OF MICROSCOPY, June, 1876;) also, W. H. Hammond, AMERICAN JOURNAL OF MICROSCOPY, July, 1878.

Herapath's iodine test. The former reagent also affords characteristic precipitates, with many other alkaloids. Picric acid, bichloride of platinum, corrosive sublimate and chloride of gold are among the most useful reagents for this class of substances.

The manipulation necessary in these reactions are simple, and no elaborate accesories are required; a polarizing prism is desirable, and a few watch crystals are convenient. A drop of the solution to be examined is placed on the concave surface of the glass; the reagent added, and if the expected reaction does not occur at once, it is covered with another, the concave surface uppermost, and set aside for a few hours for crystals to form. It is said that the formation of crystals may be hastened by pouring a few drops of ether in the upper crystal.

The application of heat to separate principles for microscopical examination is limited to volatile bases or acids, as thein or chrysophanic acid. which assumes a crystalline form, or, like hydrocyanic, can be made to crystallize by the application of reagents.

Some principles, which are not usually classed as volatile, as morphia, can be sublimed by the cautious application of a high degree of heat,* as in class just considered.

This is true I think, only because the deportment of the former bodies with reagents has been more fully studied; at least, the reactions are more decisive than with proximate principles of plants. Still, the microscope will often be found of great service in identifying many chemicals and their adulterants, and in some cases, where the physical condition of a chemical influences its value as a medicine, the microscope may afford the only means, aside from a physiological test, of determining its value.

Calomel affords an illustration of this. When sublimed, it appears under a moderately high power in crystalline fragments of considerable size, while the precipitated article is more finely divided.

Sublimed sulphur is seen as minute crystals, while the ground brimstone usually sold in its stead is in irregular crystalline fragments. The microscope affords perhaps a more satisfactory method of distinguishing kalium and natrium than the spectroscope. The alkalies, as chloride, treated with bichloride of platinum, are evaporated until crystals form, and the resulting deposit placed in the dark field of the polariscope. The crystal of the double chloride of natrium and platinum will stand out in brilliant colors, while the potassium salt will be quite invisible.

Enough has, perhaps, been said to illustrate the use of the microscope to the pharmacist, and a word in regard to the kind and price of an instrument most useful to the work in hand may not be out of place.

A very large stand is out of place in a drug store—nor should it be of the complicated structure known in microscopical parlance as "first-class." A small, low-priced stand, with two objectives and a polarizing apparatus, that can be bought for from $25 to $55, will be found the best.

Such instruments, by the best makers, are now in the market, and I believe that nine-tenths of the microscopical work is done with these third-class stands. In this connection it will not, I think, be improper to mention the "Students'" stand, made by Mr. Bulloch, of this city, costing $45. One of these stands is on the table before you, and can be examined in detail during the evening.

The Bausch & Lomb Co.'s "laboratory microscope," with two objectives (three-fourths and one-fifth inch), costs $60, and is provided with a hard rubber stage. It is a firm and serviceable instrument, but must be used in a vertical position, a necessary position while using reagents, but extremly uncomfortable to the

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*Dr. W. A. Guy, of London, was, I believe, the first to suggest this (*Microscopical Journal*, Dec., 1867) and the application of this method was extended by Dr. Helwig, of Mayence.

The most recent, and probably most valuable, contribution to this subject is a paper by J. W. Blyth, in the *Jour. Chem. Soc.*, Aug. 1878; also *New Rem.*, Oct., 1878.

The writer has not yet found time to go carefully over his reactions, but intends to do so at an early day.

operator for continued work. The "Educational" and "Family" stands, by the same firm, at $30 and $20, respectively, are worth their cost. Both are provided with rack and pinion for coarse adjustment, and the former with micrometer screw acting on stage for the fine adjusment.

The "Economic" by Beck, of London, is a small, but exceedingly well made stand. It has a rack and pinion coarse, and screw fine adjustment, two eye-pieces, two objectives (one and one-fourth inch) side condensing lens, stage forceps, etc., for $50. A polariscope is furnished for $12; achromatic condenser, without diaphragm, for $8, and camera lucida, $6. Numerous other accesories for this stand are furnished at correspondingly low prices.

It is hardly worth while to continue this list, as intending purchasers can easily inform themselves through the opticians of the various stands in the market. Suffice it to say, that those referred to, with many other low priced serviceable instruments, have been issued since the writer began the use of the instrument—not a very long time. Then the best cheap stand was Beck's "Universal," costing $50, and far inferior to the "Economic," and the purchaser would usually be shown and recommended an abominable "French Triplet," inferior in every way to the cheapest stand I have mentioned, and costing probably twice as much.

In selecting, a few essentials should be observed, as

1st. The stand should be firm in any position it can be placed for use.

2d. All the adjustments should move smoothly and without friction, and the image formed by central light should suffer no displacement on focussing up and down.

3d. The objectives should give a bright, flat field, which must be (by daylight) perfectly colorless, and when a micrometer is brought into view there should be no bending of the lines, or, with a one-fourth or one-fifth objective, but little aberration. It is hardly to be expected that the most perfect corrections will be made in the objectives furnished with these low-priced stands. For instance, I may mention that a Beck's best one-fourth inch objective costs $40, nearly as much as is asked for the "Economic," including a one-fourth; and in concluding this matter I will say that an experienced friend will be found the best guide in selecting objectives.

A few sentences more in regard to books:

Although not many general works on the microscope have been published, almost every detail of manipulation, and the preparation of objects, may be learned from those we have. The principal ones are Carpenter's, "The Microscope and Its Revelations," which has been reprinted in this country, and which covers in a general way almost the whole field of microscopic research; Beale's "How to Work with the Microscope," which is especially valuable for its descriptions of apparatus and special methods, such as photo-micrography and spectro-micrography. Cheaper than either of the foregoing is "Hogg on the Microscope," a voluminous work, and quite useful, although not as recent as the others.

A little work by John Phin, of New York, the editor of the American Journal of Microscopy, is well worth its price (75 cents) to either a beginner or expert in microscopy. I believe that, with the exception of Hassal's "Foods and Drugs and their Adulterations," and Wormley's "Microscopic Chemistry of Poisons," no special works have been published on the applications of the microscope in pharmacy. This involves some extra work to the apothecary commencing the use of the microscope, who must therefore learn to use the instrument by practice in some other field. Still, this work is of so fascinating a nature that it brings its reward along in the way of an interest that makes it a pleasure and recreation. And from the number of books devoted to medical microscopy, it is not unreasonable to expect that as soon as a demand arises for such a work among the pharmacists it will be supplied.—*The Pharmacist and Chemist.*

Microscopical Work.

THERE is at present so much dilletanteism in the use of the microscope, that the following letter from Hon. J. D. Cox is quite refreshing. It was addresed to Dr. S. C. Frink, a member of the N. I. Microscopical Society, and read before that body at Elkhart, Indiana, May 20, 1879. It was not intended for publication, and would not have appeared in our columns had it not found its way into the Goshen *Times*, and so become in a measure public property. It well deserves the careful attention of all young microscopists:

MY DEAR DOCTOR—Your very welcome letter of the 5th, finds me as much at my leisure as I am likely to be, and I accordingly begin at once to write in reply, leaving you at liberty to use as much or as little as you choose, at tho meeting of your new Microscopical Society, to which I give my most cordial good wishes, and of which I may claim by virtue of this epistle, to be a "corresponding member."

In accordance with your suggestion, I will attempt to state the opinions I have in regard to microscopical work, the best course for beginners, the tools to be used, and the advantages of co-operation.

First, then, as to the microscopical work in general.

It is notorious that the microscope has become a necessity in the advancement of nearly every department of science. Yet even to-day, too many make of it the mere plaything which it was commonly reproached with being, a comparatively few years ago. Our idea of its use should be both educational and scientific. As an educational instrument we should use its marvelous fascinations to teach ourselves and others to notice and to learn the wonders of nature about us. I have been astonished to find the way in which my little girl from the time she was four years of age became interested in seeing and learning many natural objects under the glass, and even in keeping her own little eyes wide open to find some curious object for papa's microscope. As to ourselves, the microscope should be at hand for constant use, and the habit should be formed of bringing in from every walk something to be examined in a moment of leisure. If the instrument is packed up and locked up, the trouble of getting it out will prevent much interesting investigation, whereas if the good advice of such teachers as Carpenter and Beale be followed, and the instrument be kept under a bell glass on the working table, the accessibility itself, and its presence in sight will suggest the examination of a leaf, an insect, a drop of water, a fungus, a blood corpuscle, anything which may attract the attention, and the habit of observation which is the basis of all scientific attainments will "grow by what it feeds on."

The scientific use of the instrument is double. First, to enable us to see in the natural object that which our scientific text books describe, and to know when we have under the eye that which is so taught us; and second, to push our investigation into fresh fields, or to extend the boundary of scientific knowledge beyond present limits in some department where we may hope to become expert. Every real scientific man should hope to do the latter, and we have this great encouragement, that an intelligent and industrious observer may always hope to come upon new and important phenomena, and if his eyes are taught to look, and his mind is furnished with the knowledge which discriminates between the new and the old, his discoveries may turn out to have an importance that he would not have dreamed. He need not have set out to do great things, they have in many cases come to him unexpectedly whilst he was silently and lovingly poring over the wonders and beauties of nature.

No greater mistake can be made than to say, "I would do this if I had time." We all take time for recreation, even in the busiest of lives, and if we find our recreation in the charming study of nature, experience shows that our mental recuperation is as great as if we were lounging over a sensational newspaper, whilst we are putting ourselves by this better course, in the way to take valuable steps of progress.

The first criteria of success then are, the instrument always ready for work, and the love for investigation cultivated till it becomes its own stimulus, and needs checking rather than excitement.

Second. The instrument to be used—which may be classified into, the stand, the glasses and the accessories.

My opportunities for examination and testing these have been such that I do not hesitate to express pretty decided convictions. This I will do in brief, without much argument.

In choosing a stand, the microscopist has either the means to buy the most complete instrument without regard to cost, or he must study economy. It is true that much of the best scientific work the world has hitherto seen, has been done with very cheap instruments; but there is a fallacy contained in the statement. The field of work which inferior instruments are necessarily limited to has been that first worked over. The things which were new and wonderful in science when Leuwenhoek began his investigations, are old and common now. Dallinger could do nothing in his investigation of septic organisms with the low angled glasses of the cheaper make. With regard to the microscopic stand however, skill in manipulation will go far to make up for elaborate instruments. Still, if cost were no obstacle, I should say, buy at the start Zentmayer's new Centennial Grand Model. I name this stand because it has in its construction new and real improvements which are not matters merely of choice, they are positive advantages which should not be overlooked. These are, first, the swinging sub-stage, by which all the illuminating apparatus and the mirror revolve about the object under examination as a centre; second, the fine adjustment which is unquestionably superior to any other for delicate work; and third, the adaptation of his stages to the requirements of very oblique light for some uses. But such a stand alone, with eye-pieces, but without objectives or accesories, will cost $300 or upward.

If we descend to second-class stands, there is a wider choice; but I confess to a strong opinion that second-class stands are to be studiously avoided. My opinion is clear that the choice lies between the best and the cheap working stand, provided the latter is wisely selected. He who gets a second-class stand will always be lamenting that it is not equal to the nicest manipulation, and that its cost prevents him from getting another or satisfactorily disposing of this. On the other hand, he who gets a good cheap stand will find that he can do all or nearly all that he could with any but the very best, and if he progressses, (as he ought to do) he will indulge the hope that some day he will add to it a first-class stand, when the cheap one will still be useful as his "hack," and can be carried with him when a large one could not—as upon excursions or vacation journeys, etc. Therefore I repeat, the choice, in my opinion, is very plainly between the very best, and a good cheap stand.

But it is necessary to define more closely what is a good cheap stand. It does not mean the toy stands. I will name three or four as good examples of the class I mean, though I cannot name one as so clearly ahead of others as I could in the case of the Zentmayer Centennial. Zentmayer's Histological, Beck's Economic, Geo. Wale's Continental and his "working model," are among the best of the class I refer to. Zentmayer's Histological is made with and without the rack and pinion movement for the coarse adjustment. So is Beck's Economic. Wale's have the rack and pinion on all. The first, with the rack and pinion and with two eye-pieces and two objectives, costs about $60. Beck's $50. Wale's $50, and $35, respectively. Wale's "Working Model" at $35, I think is the cheapest instrument at the price which is made. In naming these I have only named such as combine the essentials for good work. First, the rack and pinion work is smooth and good; second the fine adjustment is reliable and smooth in action;

third, the stage is adapted to both direct and oblique light, and carries the most necessary sub-stage accessories. They are all made for real work and can be trusted. The eye-pieces and objectives are about equal in them. At the same price, I should prefer Zentmayer's Histological, but the difference in cost between that and Wale's "Working Model" is considerable.

All these are furnished as binoculars at an advanced price. My own belief is that it is very desirable to use the binocular from the beginning. It is so constructed that it is changed to a monocular by the sliding of the prism, and as a monocular is as good and convenient as if solely so made. But for many uses, especially upon opaque objects, the stereoscopic effects of the binocular is so important that I rate it very highly, and more so as my experience enlarges. The only lingering doubt I have is whether the adaptation of the binocular to this class of stands is mechanically satisfactory. I think it is. The desirability of having the binocular tube I cannot overate. It is decried only by those who have no experience with it or whose eyes are not alike in focus.

With regard to objectives I would unhesitatingly say get the best. If the beginner does not, he is only making an investment to throw away. The glasses commonly sold with the cheap stands I have named are not the best, except in the case of Wale's Continental. I would therefore advise getting the stand with first-class objectives as far as they go. That is to say, I would take Geo. Wale's first-class objectives with his "Working Model," or Beck's first-class with his Economic, or Wm. Wales' 1st-class (which Z. sells) with the Zentmayer Histological. This will cost a little more at the start, but in the end it will pay.

A first rate 2 in. or 1½ in. will be more useful than two poor glasses, one being of the above focus, and the other say a 1 inch or a 2-3. The rule as to objectives cannot be made too imperative; get no poor glass. It will be a delusion and a snare. Better get along with lower powers, for if really good you can "eye-piece" them up to the magnifying power of the nominally higher one with as good results at least as with an inferior high grade glass.

The recent improvement in glasses, especially in widening the angle of aperture, makes a smaller number do the work of a full battery of the slow make.

There are four makers who now stand pre-eminent. They are Spencer and Tolles in this country, Powell & Lealand in England, and Zeiss in Germany. Others are good, but these are the first rank.

The Spencer 1-6 immersion, (if a first-rate specimen of their make) will do everything that any high power lens has been made to do, and much that the highest powers fail to do. It resolves *amphipleura pellucida* and the 16th band of the Nobert plate by lamplight, and I know of no properly authenticated proof of this being done by any 1-16, 1-25, or 1-75 ever yet made.

For these reasons a battery consisting of Spencer's best 2 inch, 2-3 inch and 1-6 may fairly be said to cover the whole range of microscopical work, with a probable need of their low angled dry 1-4 inch to fill the gap between the 2-3 and 1-6.

The first-class glasses of the other makers I have named and of the powers they furnish with the instruments named, would be sufficient for ordinary work, but for most delicate I would advise that only a Spencer 1-6 or 1-10, or a Zeiss oil-immersion 1-8 or 1-12 be thought of. By thus reducing the number of glasses, the quality can be improved without extra cost. I speak, of course, of laying out one's plan from the beginning. I myself have a number of good glasses which I would not discard to replace them by those named; but were I beginning *de novo* I could make four lenses do all that I get from a dozen I now have.

Eye-pieces can be profitably increased up to the 1-2 or 1-4 inch solid of Tolles' or Spencer's make. The A and B eye pieces are usually furnished with the instruments; beyond these I would only have the solid eye-pieces named above, not only on account of their intrinsic value, but because their construction is such that they can be easily adapted to the tube of a large instrument, if one should subsequently get a " grand stand."

As to accessories, it is advisable to have very few with the cheap stand. A cheap objective makes an all sufficient achromatic condenser. Wale furnishes with his stand an admirable iris diaphragm. These with the " Woodward prism " for oblique light tests, will enable one to do everything with the cheap stand that is done with any. I mean in the way of resolving tests, or discriminating the characteristics, etc., of substances.

Of course the polariscope, the parabola for black back ground, etc., etc., are luxuries which may properly accompany the large stand, but they are not necessities.

Such in general are the results of a good deal of observation and experience under circumstances likely to make me familiar with a wide range of instruments and of the best manipulators. I sincerely hope it may be of some use to your new society, to which I give my best wishes.

The advantages of co-operative work are chiefly found in the stimulus to make observations worth recording and worth submitting in written papers to the criticisms and consideration of other workers. Many societies only meet to look over each other's pretty specimens, or new accessories, &c. The only healthy life for such an organization is in real scientific investigation and report. I would begin by directing reports on certain subjects, elementary at first, and in all cases to be from actual work with the instrument, and widening out as the members get interested in more profound or original inquiries.

I have written at some length, but after all have only touched in outline upon the subjects you indicated. In what I have said of instruments, I may fairly add emphasis to what is written by saying that I believe it would be a matter of regret to any one investing in a microscope if he goes outside of the line I have indicated.

Very sincerely yours,
J. D. Cox.

The Thallus of the Diatomaceæ.

BY F. KITTON, HON. F.R.M.S.

Read before the Royal Microscopical Society, January 8th, 1879.

THE study of the living diatom has lately engaged the attention of many eminent foreign diatomists (M. P. Petit, Paris; M. J. Deby, Belgium; Count Castracane, M. Ardres, and others). The latest published observations are those of M. le Dr. Lanzi, of Rome, in his paper* on the "Thallus of the Diatomaceæ." By thallus is to be understood the stipes, cushion, tube, frond, or mucous pellicle. The latter is the material by which the film of diatoms is attached to wet walls, buttresses of bridges, etc. He communicates some interesting facts connected with the reproduction of these remarkable organisms. "In a gathering of *Epithemia ventricosa* made in the Villa Pamphilia, in Rome, I observed that some portions of the pellicle were composed of a great quantity of round granular corpuscles of a greenish-yellow color. Most of these corpuscles were, to all appearance, the same as those contained in the interior of the frustules of the Epithemia, and imbedded in a hyaline plasma. Such was the resemblance, that no one could doubt that the granular bodies in the plasmatic thallus and those in the frustules were alike.

" At another time I made a gathering in a fountain in the interior of the Forum of Trajan, of a Cymbella in a state of reproduction, and I was again able to see the round corpuscles. They were very small, and of the same color as the endochrome. They were contained in the thallus, and resembled those in the frustules. I followed these germs through their phases of development; and by repeated observations I ascertained that, whilst increasing in breadth they preserved their circular form: that afterwards they commenced to elongate, in order to acquire the lunate and naviculoid outline of the mature frustule.

" Of these growing forms, some remained attached to the thallus and some became free. The number of these corpuscles was considerable; and one was easily convinced that they were the result of a new kind of generation. The disparity in size was so considerable, that it would have been absurd to suppose that they had been produced by fissiparity.

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* See 'Annales de la Societe Belge de Microscopie,' vol. iv.

"I am able to report other similar facts observed in *Navicula ambigua, Nitzschia minutissima, Amphora ovalis;* but of these I shall say nothing, in order to avoid useless repetitions, and shall confine myself to describing *Gomphonema olivaceum* only, in which I have followed the series of transformations from the time the frustule containing the germs had changed into a sporangial cell, until the thallus became charged with germs and frustules in various stages of development. In this same thallus was also seen the gradual transformation of the corpuscles into rudimentary frustules, their growth, and lastly the development of the dichotomous peduncle. When this cycle was completed, the thallus contained three different forms—the sessile sphenelloid form, the pedunculate (either simple or dichotomous), and the perfect or free form. From the preceding, it appears that there arrives a time when the plasma contained in the siliceous cells acquire a considerable volume, owing to the rapid development manifested at the time of reproduction, and which cannot be contained within the walls of the frustule by reason of the want of elasticity produced by the deposition of silex. The frustules being unable to follow the growth of the plasma, the valves separate from the pressure; but previous to arriving at this condition, the protoplasm had commenced to undergo the changes necessary to the formation of the new cellules, and we are able to see an aggregation of hyaline masses destitute of an external membrane. These are the Moneres of Haeckel. Amongst them are some that remain for a long time as plastid gymnocytodes—that is to say, without an external membrane, as named by Haeckel—and form in this manner the amorphous or indefinite thallus (*mucus matricalis* of authors); whilst those that take the form of stipes, peduncles, cushions, or some definite form, appear to belong to the plastid lepocytodes, that is to say, invested with an extremely thin external membrane. This membrane, although scarcely visible with the Microscope, nevertheless limits the outline of the thallus. . . . I have determined to place the above-mentioned facts before diatomists, in order to call their attention to the study of the thallus of diatoms. The study of the function of the thallus in this large family seems to me to be full of interest."

The presence of this "thallus" is by no means uncommon. I have detected it in many diatomaceous gatherings, particularly those from fresh water, but I never saw the corpuscles Dr. Lanzi mentions; they may not have been present, or, what is equally probable, I overlooked them. However, the discovery is of great interest; and I hope, with Dr. Lanzi, that other diatomists will turn their attention to the study of the living forms. The reproduction of the Diatomaceæ has not received that amount of attention the subject deserved. Their increase by self-division was the method first observed, more careful observations led to the detection of conjugation and production of sporangial frustules, or the formation of a sporangium by a single frustule; and we now find that another method has been observed, viz. that just described by Dr. Lanzi.

The author's figure (1) represents a number of circular bodies immersed in the thallus of *E. ventricosa,* and also in the frustule (2) thallus of *Cocconema cistula,* representing the corpuscles in various stages of development. Unfortunately the amplification is not stated, a matter of some importance. It is also to be hoped that Dr. Lanzi will make some experiments to test the power possessed by them to resist desiccation without losing their vitality. In Herr Grunow's "New Diatoms from Honduras," 'M. M. J.,' vol. xviii. p. 184, Pl. 196, Fig. 4 *b,* is described and figured a curious abnormity of *Cerataulus lævis.* Within the large frustule are two very small ones. Herr Grunow asks, "In what manner do these abnormal frustules multiply and reproduce a new series of normal forms? Certainly not by conjugation or self division." Professor Cleve* figures a frustule of *Biddulphia aurita* with a small frustule within. In a note (p. 184), I suggested "that the endochrome, under certain conditions, might possess the power of producing (? by means of microspores) perfect frustules without conjugation." Dr. Lanzi's discovery confirms my supposition, and explains the formation of the small frustules within the large one.—*Trans. Royal Microscopical Society.*

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The Sexual Process in Diatoms.

AN article on this question, containing a discussion on the sexual process in general, occurs in *Der Naturforscher* for November 23, 1878. The writer begins by a statement of five methods in which the auxospores of Diatomaceæ are known to be formed: these are the following:

1. A single individual throws off both valves, secretes a mucilaginous investment, extends itself and grows. The auxospore thus formed surrounds itself with a thin membrane devoid of silica, and within this secretes the usual pair of siliceous valves, thus forming the "firstling-cell" (Erstlingzelle) of a new generation.

2. The protoplasm of a cell divides into two naked daughter-cells, which make their way out of the mother-cell, and form an auxospore.

3. Two individuals, lying close to one another, secrete an investment of mucilage; both these throw off their valves, and so form a pair of naked cells lying in close proximity to one another, but without actually touching. Both of these extend parallel to one another in the direction of their length until they attain the normal size of auxospores; outside these a thin membrane (perizonium) is found, and within this the ordinary siliceous valves.

4. Two individuals, generally surrounded by a gelatinous investment, throw off their old valves, and coalesce into a single naked mass of protoplasm, which grows into a single auxospore.

5. Two individuals, again surrounded by mucilage, throw off their old valves, and each divides transversely into two naked daughter cells, each of which then coalesces with the corresponding daughter-cell of the other individual. Two naked zygospores are thus formed, each of which becomes an auxospore, and subsequently, by the formation of siliceous valves, a firstling-cell.

Of these five methods the fourth and fifth are certainly sexual, being a process of zygospore-formation. The first mode is as certainly asexual, a process of cell-formation by rejuvenescence, so that in the single group of *Diatomaceæ* the auxospores, by which a new generation is started, may be produced either sexually or asexually.

The second mode requires further investigation: about the third there is a difficulty; it is a process of rejuvenescence, taking place, however, only when two individuals are present; so that a mutual action, independent of actual contact, is evidently exerted. This process the writer compares to the mode of fertilization in *Florideæ*, where cells far removed from the trichogyne, to which alone the fertilizing influence of the spermatia is applied, are stimulated to a new and vigorous growth by the impregnation: and to the process which obtains in Phanerogams, where the protoplasms of the male and female cells are separated from one another by the cell-wall of the pollen tube. In both these cases, however, one of the sexual cells only (the female cell) undergoes further growth, the other or male cell disappearing; while in the desmids in question, the action of the two cells is mutual.

The writer then defines sexuality as the action of two or more cells on one another, by means of which a new process of growth, in one or all of these cells, is set up, and the sexual action consists in the stimulation of the sexual cells to a new and particular growth, such growth being impossible without that stimulation.—*Trans. Royal Mic. Soc.*

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* 'Bihang till Vet. Akad. Hand.,' band i. tab. iv., fig. 3, *a b*.

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FOR many years the number of our Post-Office Box has been 4,875. Recently, however, all numbers above 4,500 have been closed, and we have been assigned to Box 2,852. Our correspondents will please make a note of this change.

Alleged Improvements in the Microscope.

OUR attention has been called to several articles which have lately appeared in English and American Scientific journals, and which describe certain alleged improvements in the construction of the microscope, whereby the most wonderful results are said to be attained. From a recent issue of the *Scientific News* we clip the following:

The following points are submitted by the undersigned to the Academy of Sciences, in the belief that, however extraordinary may seem the conclusions derived from them, the facts themselves will be considered of sufficient importance to be carefully examined and verified. The data rest, in the main, upon the testimony of a discovery of the writer respecting the properties of object-glasses, practically applied to the structure of lenses, by means of which he has been enabled to construct an objective of the focal distance of one millimetre, having, reckoned in diameters, 6.4 times, or, reckoned in areas, 40 24-25 times, the power of such an objective constructed according to formulæ now in use among the best opticians. The first objective constructed upon this principle was based upon a Bardou No. 10, of the ordinary continental pattern; the combination, with C eye-piece, and tube 0.4 of a metre, or 15.6 inches in length, yielding, with fine definition and penetration, and extraordinary resolution, a power of 12,600 diameters. Applying the same formula to a wide-angle objective of one millimetre focal distance, the result has been a power of 50,400 diameters, as near as it is possible to calculate an instrument of such delicacy. The calculation of power was made in the following manner: With C eye-piece and tube undrawn, a wide-angle Wales objective of of one millimetre focal distance was applied to the instrument, and the power, measured with an eye-piece micrometer, found to be 2,100 diameters. Placing a stage micrometer under the lens, the tube was then drawn until the diameter of the pencil, of rays transmitted—that is, of the field of vision—was exactly 0.005 of an inch. On applying the Bardou as reconstructed, without alteration of these conditions, the diameter of the pencil transmitted was found to be 0.0008 of an inch, or a l ttle less than one-sixth that of the Wales. At this power three colored corpuscles of human blood, placed in linear series, spanned the field of the instrument. The power could, of course, be found by the proportion: as .0008 is to .005 so is 2,100 to 13,125. I now slowly pushed in the draw-tube until the field of the Bardou was exactly one-sixth that of the Wales, and the power properly represented by 12,600 diameters, instead of 13,125. Upon this basis I then measured the field of the one millimetre (more properly, 1-25 inch) objective, altered in the same manner as the Bardou No. 10, and found it to be exactly 0.00025 of an inch: yielding upon the proportion previously applied a power of 40, 20 diameters. My next movement was to draw the tube until the diameter of the pencil was reduced to 0.0002 of an inch, and the power increased to 50,400 diameters.

I am fully aware how thoroughly fabulous such a statement of power must seem, about 10,000 diameters being the highest result obtained with the Tolles 1-75 inch, recently exhibited before the New York Academy of Sciences; but I trust I shall be believed when I affirm that, with an ample working distance, the Bardou No. 10 I have just described is superior in power, definition, penetration, and resolution to the Tolles; being, with the exception of the 1-25 inch more recently constructed, the most powerful microscope objective in the world. An entire corpuscle of human blood cannot be viewed at one time with the 1-25 inch as now arranged, and it requires only ten of the little bodies styled monads to fill the worker's vision completely. Yet the defining, penetrating, and resolving properties of the lens are perfect, and the perimeters of the monads are sharply defined.

The writer then goes on to describe certain observations and speculations in regard to the ultimate constitution of albumen and lymph, but as the accuracy of these must depend wholly upon the efficiency of the objective, it is unnecessary to do more than allude to them.

As regards the alleged improvements in objectives, we confess that we cannot understand how any respectable scientific journal should have published such a farrago of nonsense. Like all other charlatans, Mr. Fairfield attempts to conceal the methods by which he reaches his results, and so long as he dealt in mere assertions of *results*, it was impossible to do more than merely deny his statements; but when he attempts to give even the slightest hint as to the *modus operandi*, he at once betrays the absurdity of his pretensions.

Every microscopist knows that the magnifying power of the usual combination of which an ordinary objective forms a part, may be indefinitely increased by the use of either amplifiers, deep eyepieces, or long tubes, or all combined. This has been done over and over again, but never with satisfactory results. It is not many years since similar astonishing claims were made by a gentleman of New York, who, by means of amplifiers obtained a magnifying power of 80,000 or 100,000 diameters, and with sufficient clearness of definition and resolution to show the markings on *P. Angulatum.* Mr. Fairfield claims that his Bardou objective gives, after being modified, fine definition and penetration, and extraordinary resolution. Few of our readers, we presume, have seen a "Bardou" objective. It is merely a common French triplet, and although Bardou is famous for his opera-glasses, we have never heard that his microscope objectives were regarded with much favor. It would astonish us very much to learn that Mr. Fairfield had succeeded in resolving the *P. Angulatum*, dry, by means of his Bardou objective, and as for the same object in balsam, we feel tolerably sure that it is utterly beyond his reach.

Mr. Fairfield's method of measuring the magnifying power of his objective, is, to say the least of it, original.

We should not have wasted so much space over such a matter, if it had not been that the alleged improvements have been announced with such a flourish of trumpets that they are likely to impose upon those who, though well informed otherwise, are not familiar with microscopic matters. Even the *Engineer* (of London) has been led into publishing Mr. Fairfield's paper, and the editor of the *Scientific News* is so unfamiliar with microscopical matters as to be led into the following utterance:

> This enormous stride must have the effect to bring the name of Prof. Fairfield prominently before the entire scientific world, as one of the most deserving of those upon whom science delights to bestow its honors.

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BOOK NOTICE.

Plain Directions for the Construction and Erection of Lightning Rods. By John Phin, editor of the "Young Scientist," and the "American Journal of Microscopy." Third Edition, Enlarged and fully Illustrated. Cloth, 30 cents. New York; Industrial Publication Company.

The season is now approaching when the voice of the lightning rod man will be heard in the land, and thousands of dollars will be spent in putting up rods, three-fourths of which will probably be useless, for it is an unfortunate fact that the average peddler of lightning rods thinks more of the money that he gets than of the protection which he furnishes. Indeed, so common is it for lightning rods to be defective, that many persons have been led to entirely doubt their efficiency, and yet, no fact is more thoroughly established than that a good lightning rod affords perfect protection.

The work before us is the only one within our knowledge that has not been published for the purpose of puffing some patent; it is short, simple, and fully illustrated, and the practical directions are so full, that any ordinary mechanic can, by following them, put up a really good rod. And it is a comforting assurance to be told that a really good rod need not infringe any patent, the best methods of construction being older than any patents now in force.

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TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

New York Microscopical Society.—The regular conversazione meeting was held May 16, 1879, Mr. G. I. Whitehead, as President, pro tem., in the chair.

Dr. D. Benson, of Hoboken, N. J., was elected an active member.

Donations received: From Messrs. Hitchcock & Wall, the April number of the "American Quarterly Microscopical Journal," and fifty copies of the Transactions of this society; from its publishers, Vol. 2, No. 7, of the "Science Observer;" and from the author, Mons. M. A. Certes, Paris, France, a copy of his monograph, "Sur une Methode de Conservation des Infusoires," illustrated with beautiful colored plates. For each of these contributions a vote of thanks from the society were tendered. A package of Drakesville diatoms was received from the Recording Secretary. A package of material was ordered sent to Mr. Peticolas, of Richmond, Va., as a partial exchange for valuable slides of diatoms, received from him last year. There were exhibited by Mr. Hitchcock, gathered by him at Port Morris—Oscillatoria sp.; Spirogyra quinnia; S. vivularis; Entomorpha sp.; Vaucheria sp.; and of living diatoms Bacillaria paradoxa, Pleurosigma angulatum, etc.; besides by others, objects of general interest.

The regular meeting of the Society was held June 6, 1879, President Hyatt in the chair.

Donations received: The "Transactions of the Wisconsin Academy of Sciences," Vol. 4, for 1876-77; also two numbers of the Naturalist's "Leisure Hour," from the Academy, and the publishers. Thanks for the same returned. From Mr. J. E. Ingpen, Hon. Secretary, two valuable numbers of the "Journal of the Quekett Club," containing rules and list of members; the forthcoming numbers offered as an exchange. For this favor a vote of thanks was tendered to Mr. Ingpen, and to the

Quekett Microscopical Club of London. From Mr. Hyatt, a nice bulls-eye condenser, which he had constructed for, and presented to the society.

Mr. C. F. Park, of Englewood, N. J., was elected an active, and Dr, Carl Seiler, of Philadelphia, an associate member.

A letter was received from Dr. R. H. Ward, of Troy, President of the American Society of Microscopists, requesting that this society be represented at the National Meeting to be held at Buffalo beginning Aug. 19. It was resolved that the invitation be accepted, and that the President shall give letters, as credentials to those members who may wish to go, and represent this society at that time.

Mr. Hitchcock addressed the meeting "On the Algæ, etc., found by him in this vicinity this season." His observations were chiefly made upon the Spirogyra, showing the gradual change of form in their interior parts. He also found that Euglena were filled with cells appearing like starch grains, which afterward seemed to change into young Trachelomonas, as was well seen by placing them on a Holman slide, where their growth and action can be well observed.

The regular conversazione meeting was held June 20, 1879, President Hyatt in the chair, 13 members present.

Mr. C. W. Rabadan, of New York, was elected an active member. Also Dr. Chas. L. Swasey, New Bedford, Mass.; Prof. A. H. Chester, of Hamilton College, Clinton, N. Y.; and Mr. Thos. Taylor, Microscopist, Department of Agriculture, at Washington, D. C., as associates.

Mr. Hitchcock exhibited twelve photographs all made by Dr. J. J. Woodward, of Washington, D. C., which had been presented to Mr. H., all of them of the diatom A. pellucida, as resolved by the following lenses, viz: Powell & Lealand's 1-8, 1-16 and 1-25 water immersion; Spencer's 1-10 water immersion, and 1-6 glycerine immersion; Zeiss' 1-8 and 1-12 oil immersion; Tolles' 1-10 oil immersion and 1-18 water immersion. Most of these pictures were clear, and seemed to prove these lenses (with two exceptions) to be of from good to very fine definition and resolving power.

There were exhibited, among many objects of general interest, by several members, the following of special note: By Dr. Frank M. Deems, a parasite found in the eye of a common house fly, mounted in glycerine; by Mr. J. L. Wall, sori of fern ("Dicksonia punctutabula"); and by Mr. Shultz, Volvox globator, red cantho camptus, etc.

Upon motion, it was resolved that the society adjourn to Friday, Sept. 5, 1879.

CHAS. S. SHULTZ, Recording Secretary,
Hoboken, N. J.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales and purchases for cash must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Will exchange for well-mounted objects, human teeth sections from any part of tooth desired. H. A. Moyer, Kendallville, Ind.

Slides of pine pollen, so-called sulpher shower, which fell in eastern Pennsylvania, March 17. Diatoms, vegetable stainings, etc., in exchange. C. Henry Kain, 524 Cooper street, Camden, N. J.

Wanted, a good stage micrometer, in exchange for fine diatoms and other desirable material. M. A. Booth, Longmeadow, Mass.

Wanted, an achromatic condenser and fitting, or Wenham's parabolic reflector, in exchange for books on medicine, or state what is wanted, H. V. H., P. O. Box 47, Coeymans, Albany Co., N. Y.

Slides of Nummilitic limestone from Pyramid; foraminiferous limestone, India; deep sea dredgings, various parts; Sertularia. Histological or pathological specimens preferred. Dr. Chas. L. Swasey, New Bedford, Mass.

I have for exchange a Kinne self-centering turntable with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypeus, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod, and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¼ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 243, Greenport, Suffolk County, N. Y.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 636, New Britain, Conn.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

VOL. IV. NEW YORK, JULY, AUGUST, SEPTEMBER, 1879. Nos. 7,8,9.

Observations suggested by the Study of Amphipleura pellucida, mounted in Canada Balsam, by Lamplight and Sunlight, with various Objectives.[*]

BY J. J. WOODWARD,

Surgeon and Brevet Lieutenant-Colonel U. S. Army, Hon. F.R.M.S.

IN the latter part of October, 1878, I received from Carl Zeiss, of Jena, two objectives, a one-eighth and a one-twelfth, both "oil-immersion," or as they are now called by their maker, "objectives for homogeneous immersion." To test their performance, I made with them some photographs of *Amphipleura pellucida* mounted in Canada balsam, and, for comparison, photographs of the same frustule, with several other objectives. On January 20, 1879, I wrote to Zeiss a brief account of these experiments, and sent him a set of the photographs, together with a duplicate set for Professor E. Abbe, of Jena. I learn from the Journal[*] that Professor Abbe promptly sent one set of these photographs, together with my letter, to Mr. J. W. Stephenson, who exhibited the photographs and read parts of the letter at the meeting of the Royal Microscopical Society, February 12, 1879.[†] This circumstance, which was fully in accordance with permission granted in my letter to make public use both of it and the photographs, would render it unnecessary for me to do more at present than to send duplicates of the photographs for the cabinet of the Society, but that, since writing to Zeiss, I have made photographs of the same test with several other notable objectives, especially a one-sixth glycerine-immersion by Spencer, and a one-tenth oil-immersion by Tolles, and that the results induced me to make a new series of comparative photographs with the best objectives at my disposal, including, of course, those of Zeiss. This new series I now send to the Society instead of the original one.

Several matters of interest were first noticed or strikingly illustrated during the progress of the work, and to these it is the object of this paper to draw attention.

I. The first point was brought out during the original series of experiments, and was detailed in my letter to Zeiss, but does not appear to have been read to the Society, viz., the best mode of projecting images upon the screen for photographic purposes with such objectives as those of Zeiss. These objectives, it will be remembered, have no screw-collar adjustment, and their aberrations are completely corrected only when the focal adjustment is such that the image is formed at a fixed distance, which, in the case of the two objectives sent me, is ten inches. Now, to obtain the magnifying power I desired for the photographs, from ten to fifteen times this distance is required, and it would at first sight appear necessary for this purpose to bring the objective so much closer to the object than the position for which alone it is corrected, that the resulting aberrations would quite destroy the definition of the image. This difficulty appears to have occurred to Zeiss himself before he sent me his objectives, for he voluntarily furnished with them two concave lenses, said to be of 25 and 30 centimetres focal length, which he directed me to screw immediately into the posterior part of the brass mounting of the objectives when I used them for photography, and by which he supposed the aberrations introduced by distance would be corrected. One of these concaves was intended to correct the aberrations when the image was projected to 1·5 or 2 metres distance; the other was expected to answer the same purpose at the distance of 3 metres or upwards.

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[*] Read before the Royal Microscopical Society, June 11th, 1879.

[*] Vol. ii (April, 1879), p. 214.

[†] *Op. cit.*, p. 140.

If Zeiss consulted his distinguished adviser, Professor Abbe, as to the formulæ for these concaves, I do not doubt that he was correctly instructed; but if so, the lenses as actually sent do not correspond very precisely with the mathematical requirements. I tried them faithfully, and wrote to Zeiss as the result of my examination, that when I came to study the images produced with these concaves at the distance directed for each, "I became painfully aware that a curvature of field had been introduced which did not belong to the image as viewed with the 10-inch tube, while great loss of definition indicated the presence of considerable spherical aberration in the new combination." Photographs taken under these circumstances were exceedingly unsatisfactory, and had no other means of projecting images with these objectives been available, I should not have succeeded in presenting a photographic demonstration of their excellent qualities.

But long before I received them I had theoretically devised a method for making these projections, which on trial fully answered my expectations, and gave, at any distance I chose to select, images quite equal in flatness, definition, and brilliancy to the best I could obtain with the 10-inch tube. This method consists in placing a suitable achromatic negative lens at the end of the draw-tube of the microscope body, and slipping it by trial to the proper position to bring the image to a sharp focus on the screen at the distance selected, while the objective remains in precisely the same focal position that was found to give the best image with the 10-inch tube. The course of the rays through the objective under these circumstances remains the same whether the image is projected to 1 or 4 metres, or any intermediate distance, and, provided the concave has the requisite qualities, the sharpness of the image is unimpaired.

For this purpose I had selected an "amplifier" made for the Museum more than ten years ago by Mr. Tolles, of Boston. It was originally intended to be used at the end of the draw-tube in ordinary microscopic work for the purpose of obtaining increased magnifying power. This "amplifier" was a negative achromatic meniscus of about 6·5 inches virtual focus and ·7 of an inch in diameter. I had in the Museum collection a number of other "amplifiers" specially constructed for the projection of microscopic images, but knew by previous experience that none of them equalled the Tolles' amplifier in flatness of field or freedom from spherical aberration. After failure with the Zeiss amplifier, therefore, I tried this Tolles' amplifier in the manner I had originally intended, and after some little experiment to ascertain its proper position in the microscope body for the distances at which I designed to form the images, I obtained the results at which I aimed.

It will readily be understood that the best position of the amplifier with the Zeiss one-eighth or one-twelfth for the projection of the image to say 10 feet distance from the object, will also be the best position for all other objectives, provided their corrections are best neutralized when they are focussed on the object with the 10-inch tube, and therefore the positions of the draw-tube corresponding to the best images at a series of selected distances having been found by careful experiment with any selected objective, may be used successively with any other objective corrected for the 10-inch tube. Indeed this method may be advantageously resorted to in the case of objectives provided with a screw collar, in place of the usual method in which the screw collar is used to correct the aberrations introduced by distance. The positions of the amplifier, as indicated by the scale on the draw-tube, having been found for the distances at which the pictures are to be taken, it is only necessary in subsequent work with the same amplifier, to set it, by means of the draw-tube, at the position known to be best for the distance selected, and then to focus with the fine adjustment in the usual way.

It was in this manner that the images were projected for the photographs I sent to Zeiss, and for those which accompany this paper. I am pleased to observe by his printed circular, dated March, 1879, that since he received my letter in which this method was explained, and the photographs sent with it, Zeiss has been influenced by them to construct and advertise for sale a concave lens of 10 or 12 centimetres focus, to be placed at the end of the draw-tube (in das Auszugsrohr des Tubus eingesetzt), for the purpose of projecting images with his objectives, instead of the unsatisfactory device he offered me last fall. I regret to find, however, that I have unintentionally misled Zeiss as to the focal length of the amplifier I used. Copying by accident from my note-book a memorandum referring to another amplifier, I wrote him that it had a virtual focus of about 12·5 centimetres, whereas its focus is really somewhat more than 16.

I do not, however, doubt in the least that excellent results may be obtained with a properly constructed amplifier of the focal length he has adopted, and can express no opinion as to how far he has succeeded in this direction, because I have not yet seen one of those he is making. But I must point out that it is not enough to have a properly constructed amplifier, and to screw it at the end of the draw-tube; it is also of prime importance that the proper position of the amplifier should be found for the distance selected. If this is neglected, very unsatisfactory results may be obtained with excellent instruments.

I must add, that the plan of using a negative lens behind the objective, for the purpose of increasing the size and flatness of the image formed by a solar or gas microscope on the screen, is quite an old device, as is also the plan of using a negative lens between the eye-piece and objective (preferably at the end of the draw-tube) for the purpose of increasing the magnifying power of the microscope. I was, however, the first to point out the advantages of employing a suitable achromatic concave in place of the eye-piece of the microscope for the purposes of photo-micrography. I had already published a preliminary notice of this method in 1865,* and described it in more detail in 1866.† Since then I have repeatedly, in published articles, in private letters, and by word of mouth insisted upon this point, until it has become so familiar that some of my correspondents imagine it to be their own contrivance. I have not hitherto, however, nor has any other microscopist, to my knowledge, commented upon the important application of the achromatic concave described above, in which, by giving it suitable focal length and position, it is used to project the image upon the screen while the object-glass is in precisely the position with regard to the object that it would occupy in ordinary work, and the course of the rays through it quite the same.

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*Circular No. 6. War Department, Surgeon-General's Office, Washington, 1865, p. 149.

†'American Journal of Science and Arts,' vol. xlii. (1866) p. 189; also 'Quarterly Journal of Microscopical Science,' vol. vi. (1866) p. 166.

II. The second point to which I wish to call attention relates to the obliquity of the illuminating pencil necessary to resolve difficult lined test objects, such as *Amphipleura pellucida* mounted in Canada balsam, by objectives of adequate aperture. Until a comparatively recent period many respectable microscopists still clung with affection to the singular theoretical error that the angle of aperture of immersion objectives, as measured in a medium (such as Canada balsam) of about the index of refraction of crown glass (it has been the fashion to call it the balsam angle), could by no means exceed double the angle of total reflexion from glass to air, which theory indicated as the limit for dry objectives. It is now universally admitted by the physicists and mathematicians whose attention has been directed to the subject, that this limit, inflexible as it necessarily is for dry objectives, has nothing whatever to do with the question of the aperture of immersion objectives, which indeed, from this point of view, would be limited only by double the angle of total reflexion from glass to the immersion fluid. The adherence of any individual microscopist to the old error is therefore no longer of importance, and the practical opticians, acting in strict accordance with correct theory, have succeeded in constructing water, glycerine, and oil immersion objectives, not merely exceeding 82°, but attaining 100°, 115°, and even, in the case of one well-known maker, over 120° balsam angle for an oil-immersion objective. The limit of improvement in this direction is not yet attained.

Professor Abbe has recently announced his expectation* that it will be possible in the near future to construct objectives having an aperture of 128° in a medium of 1·50 index of refraction. That this expectation will be realized, and with resulting improvement in defining power, I do not doubt in the least, but cannot believe that the limit will be found even here.

But while the correct views with regard to the aperture question are now generally accepted, and a number of practical opticians are making use of this knowledge in the construction of improved objectives, we hear it continually asserted of late, that no advantage can possibly be derived from the excess of angle in immersion objectives beyond the much-talked-of 82°, unless immersion illuminators are used to throw the illuminating pencil upon the object with an increased obliquity corresponding to the increased angle of the objective.

This statement, which is an exceedingly exaggerated one, has been so loudly reiterated, and has been accepted, without special investigation, in such high quarters, that I have thought it worth while to take this opportunity of drawing attention to the actual facts. It is quite true that when a feeble source of illumination, such as a coal-oil lamp, is employed, it is necessary to use an immersion illuminator by which the light can be thrown upon the object more obliquely than would otherwise be possible, whenever we desire to obtain the best possible resolution of difficult lined test objects with objectives whose balsam angle exceeds 82°. It is also true that the performance of these objectives on histological and other preparations, when the illumination is effected by means of a central pencil of light from a coal-oil lamp, is much improved if an immersion condenser of aperture equal to that of the objective be substituted for the ordinary dry achromatic condenser.

But notwithstanding those notable and practically important facts, it is nevertheless equally true that without these valuable accessories the new immersion objectives greatly excel any dry objectives in defining power, both by oblique and central light, provided only that the objects examined are mounted in Canada balsam, or if dry, are adherent to the under surface of the glass cover. Under the same circumstances also, immersion objectives whose balsam angle exceeds 100°, excel in definition immersion objectives of smaller angle. Thus, several of the immersion objectives in the Museum collection which have an aperture greater than 100° balsam, will resolve the 19th band of the Nobert's plate by lamplight thrown obliquely upon the under surface of the slide by an ordinary small bull's-eye condenser, a feat which no immersion objective of smaller angle, and no dry objective, can be made to perform; and the superiority of the definition of these wide-angled objectives, when used to examine histological preparations, bacteria, and the like, illuminated with central light, by the ordinary dry achromatic condenser, is readily recognizable by the practised eye.

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*"Ueber Stephenson's System der homogenen Immersion bei Mikroskop-Objectiven," "Sitzungsberichte der Jenaischen Gesselschaft fur Medicin und Naturwissenschaft," Jan. 10, 1879.

These easily verified observations are quite in accordance with the accepted theory of microscopical vision. It has long been practically known, in the case of dry objectives, that those of great aperture exhibit to a marked degree the superior defining power thence resulting, even when the object is illuminated with perfectly ceentral light; and the well-known theoretical explanation of this phenomenon is equally applicable to the case of immersion objectives so long as no film of air intervenes between the object and the front of the objective.

But the superior defining power of wide-angled immersion objectives, when illuminated by central or moderately oblique light, is still more manifest when monochromatic sunlight is employed; and this fact is strikingly illustrated by the photographs which accompany the present paper. A converging pencil of monochromatic sunlight, obtained by a 3-inch objective of about 12° aperture, with its optical axis inclined at an angle of about 45° to the optical axis of the microscope, will be found quite oblique enough to give magnificent resolution of *Amphipleura pellucida* mounted in Canada balsam, without the use of any immersion illuminator, although in this case it is evident that in consequence of refraction at the under surface of the glass slide, the axis of the illuminating pencil actually impinges upon the frustule at an angle of little more than 27° to the optical axis of the microscope. If, now, with the illuminating pencil rigidly limited to this angle, a selected frustule of *Amphipleura pellucida* in balsam be examined successively by a series of immersion objectives, the superior definition of those of greater angle will be readily observed by the eye, and if photographs are taken, will be equally manifest in them.

In the series of photographs of *Amphipleura pellucida* that accompany this paper, those numbered from 1 to 11 were all taken with the angle of the illuminating pencil just mentioned, and will serve to illustrate the accuracy of the statement made. The explanation is quite obvious, for with sunlight the diffraction pencils that radiate from the transparent spaces in the frustule are of sufficient brilliancy to form a very conspicuous part of the image, if brought to a focus by the objective; and just what part of these pencils shall actually be brought to a focus as part of the image, depends in each case upon the aperture of the objective and not upon the obliquity of the illuminating pencil. On the other hand, by lamplight these diffraction pencils are so much less brilliant that they are inadequate to secure resolution, and it is necessary for this purpose to use much more oblique illumination than will answer the purpose by sunlight.

In view of the foregoing considerations, it is not surprising that, in the case of monochromatic sunlight, an increase of the obliquity of the illuminating pencil produces no such marked improvement in the performance of the objective as occurs under the same circumstances by lamplight. To illustrate this fact I have added the photographs numbered 12 and 13, representing the same frustule, as seen by means of an immersion illuminator, with the most oblique light that could be used with each objective without distorting the image. A comparison of these pictures with those taken by the same objectives with the smaller angle of illumination, shows that the improvement resulting from the increased obliquity is very trifling indeed. These pictures will serve to illustrate the general statement that with illumination by monochromatic sunlight, and consequently for the purposes of photo-micrography, the superior definition of objectives of greater balsam angle than 82° is independent of any excessive obliquity in the illuminating pencil, and of the use of immersion illuminators. Indeed, as I shall take occasion to illustrate hereafter by photographs, it is almost quite as manifest with histological preparations and central light as with lined test objects and oblique light.

III. Of the photographs which accompany this paper, Nos. 1 to 13 inclusive are representations of a frustule of *Amphipleura pellucida* from a slide mounted in the Hull Botanical Gardens in 1859. This slide was given to Mr. Wm. A. Sullivant, of Columbus, Ohio, and by him presented to me in May, 1867. As it came into my possession it was a dry mount with the frustules adherent to the cover; but for the purposes of these experiments I have remounted it in Canada balsam. Of course the difficulty of resolving so delicate an object as *Amphipleura pellucida* is somewhat increased by mounting it in Canada balsam. In January, 1852, Professor Bailey, of West Point, writing to Matthew Marshall, Esq., of the surprising performance of the wide-angled dry lenses just constructed for him by Charles Spencer, declared, "In all these cases (and, in fact, whenever I allude to a test object) I mean the *balsam*-mounted specimens. The dry shells I *never* use as tests." It is amusing at the present day to note how "extraordinary" this assertion then appeared to one of the most distinguished English microscopists, who contrived then, as he has more than once subsequently done, to misunderstand completely the reasoning of the "American opticians," and who boldly wrote, "I have invariably found that when very difficult tests are mounted in balsam I cannot discover the markings."*

At the present day the value of difficult test objects mounted in Canada balsam is more correctly appreciated; and among these one of the most convenient and useful is *Amphipleura pellucida*. It is not many years since this diatom, even when mounted dry, was regarded as one of the most difficult tests. Messrs. Harrison and Sollitt indeed appear to have glimpsed the striæ on the dry mount as early as 1854; but can only have glimpsed them, for they estimated the number at 120 to 130 in the 1-1000 of an inch, an estimate to which Mr. Sollitt stoutly adhered as late as 1860.* Most other microscopists were unable to verify these observations. Messrs. Sullivant and Wormley† declared that they had "not been able to 'glimpse' the striæ on this diatom." And when Mr. Sullivant sent me the Hull slide he had still been unable to resolve it, as indeed was true of almost all microscopists at that date.

So far as I have been able to learn, Messrs. Powell and Lealand were the first who succeeded in resolving the dry frustules with sufficient distinctness to get correct notions of the fineness of the markings. We learn by a note from Mr. Lobb, dated January 12, 1870,‡ that those gentlemen had at that time succeeded in resolving *Amphipleura pellucida* with their immersion one-eighth, one-twelfth, and one-sixteenth, and estimated them at 100 to the 1-1000 of an inch. I myself first succeeded in resolving and photographing this diatom in January, 1871, and it was a Powell and Lealand immersion one-sixteenth that did the work. In a memorandum published by the Surgeon-General's Office, February 1, 1871 (and republished in the 'American Journal of Science and Arts, vol. i. (1871) p. 345), I stated that I found the striæ on medium-sized frustules counted from 90 to 93 to the 1-1000 of an inch. I found no example in which the number of striæ exceeded 100 to the 1-1000 of an inch. Since then I have examined a considerable number of *Amphipleura* slides, and only occasionally found one still finer. The finest I have ever counted had 107 striæ to the 1-1000 of an inch. Ever since January, 1871, *Amphipleura pellucida* has been one of my favorite test objects for immersion objectives. In June, 1871, I succeeded in resolving it by an immersion one-fifth of Tolles,[*] and in March, 1872, in connection with its resolution by certain objectives made by R. and J. Beck, and by William Wales, I wrote :—"This diatom is a useful and valuable test for immersion objectives of one-eighth inch focal length or less. Lower powers can only hope to resolve it if possessed of excessive angular aperture."[†]

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*See "Quarterly Journal of Microscopical Science," vol. ii. (1854) p. 214.

*Ibid., vol. viii. (1860) p. 48,

†"On the Measurement of the Striæ of Diatoms," the 'American Journal of Science and Arts,' vol. xxvii. (1859) p. 250.

‡Monthly Microscopical Journal vol. iii. (1870) p. 104.

Meanwhile, although I constantly wrote and spoke of the dry frustule, because it gave more brilliant images as I then handled the test, I had already, in January, 1871, resolved with the immersion one-sixteenth of Powell and Lealand, several balsam-mounted slides of the same diatom, which Mr. Sullivant had kindly sent me. In February, 1871, Count Castracane wrote from Rome to the Royal Microscopical Society,[‡] that the year before he had succeeded in obtaining a photograph of *Amphipleura pellucida* on a Moller's test-plate, balsam mounted, first with a Hartnack immersion No. 10, and afterwards with an objective of the same number by Nachet. The degree of success attained by this distinguished microscopist may be inferred from his own frank acknowledgment:—"Unfortunately my negative was blurred and rather faintish, so that it could not give good positive images. Nevertheless, the striæ are there so finely and so distinctly drawn out, that they may be perceived clearly enough, though the magnifying power of the microscope was not higher than 640 diameters."[§] I myself in March, 1872, wrote in a general way of the resolution of the balsam-mounts:—"I may add that any of these objectives, including the Beck's one-tenth, will resolve *Amphipleura pellucida* in balsam, as in fact was done by Count Castracane, with objectives by Hartnack and Nachet."[*]

But all this was by monochromatic sunlight, and it was not until I began to use immersion illuminators with objectives of more than 82° balsam angle, that I succeeded in obtaining satisfactory resolution of the balsam-mounted frustules illuminated with an ordinary coal-oil lamp. Even then it was by no means with every immersion objective of sufficient aperture that satisfactory resolution could be obtained; but during the last six years the number of objectives capable of resolving this test has been constantly increasing, and the sharpness of the images produced by the very best objectives has continually improved, until at the present day I have no hesitation in making the assertion that any first-rate immersion objective, even those of as low power as the one-fourth, ought to be able to give distinct resolution of the most finely marked frustules of *Amphipleura pellucida* mounted in Canada balsam. Those incapable of this performance must be classed among second-rate objectives, and will not willingly be employed in serious investigations by instructed microscopists. As for the appearance of balsam-mounted frustules of this diatom by sunlight, under the best modern immersion objectives, it not only rivals in vigor and contrast the finest views of the dry frustules, but greatly excels the best that can be done with these in simultaneous exhibition of the details of outline and midrib.

The frustule on the Hull slide selected for photographic representation in connection with this paper is ·0037 of an inch long, and has 102 striæ to the thousandth of an inch. At the distance of ·0011 of an inch from it, and nearly parallel to it, on the slide is a second rather more coarsely marked frustule, the appearance of which in the pictures will aid in forming a judgment of the flatness of field in each case. Near one extremity of the selected frustule appears the end of another that may be used for the same purpose, while near its other extremity the end of yet another frustule is seen, at right angles to it, which, from its position in relation to the light, is not resolved, although longitudinal diffraction lines appear upon its surface in all the pictures.

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[*] See 'Monthly Microscopial Journal, vol. vi. (1871) p. 150.

[†] Same Journal, vol, vii. (1872) p. 166.

[‡] Same Journal, vol v. (1871) p. 176.

[§] *Loc. cit.*

[*] Same Journal, vii. (1872) p. 233.

All the immersion objectives belonging to the collection of the Museum will show the striæ on the selected frustule by monochromatic sunlight; but some of them, from curvature of field and feebleness of definition, would have given but sorry pictures. I have only thought it worth while to make photographs with a few of the very best of the water-immersion objectives at my disposal, and with certain glycerine and oil-immersion objectives. The following is a list of the photographs, to which I have added a memorandum of the aperture of each objective, as measured with an instrument I have devised, a modification of the apertometer of Abbe, which I will describe fully in a separate paper. The angles are all computed for an ideal medium of 1·5 index of refraction.

(*a*) *Photographs of* AMPHIPLEURA PELLUCIDA. *illuminated by monochromatic sunlight. Condenser a 3-inch objective of 12° air aperture inclined at an angle of 45° to the optical axis of the microscope.*

No. 1. Oil-immersion one-twelfth, aperture 114°, by Zeiss, vignetted print. 2830 diameters.

No. 2. By the same objective; print not vignetted. 2760 diameters.

No. 3. Oil-immersion one-eighth, aperture 115°, by Zeiss. 2700 diameters.

No. 4. Oil-immersion one-tenth, aperture 122°, by Tolles. 2700 diameters.

No. 5. Glycerine-immersion one-tenth, aperture 105°, by Spencer. 2830 diameters.

No. 6. Glycerine immersion one-sixth, aperture 106°, by Spencer. 1900 diameters.

No. 7. Enlarged from the last negative to 2760 diameters.

No. 8. Water-immersion one-eighteenth, aperture 91°, by Tolles. 2760 diameters.

No. 9. Water-immersion one-eighth, aperture 105°, by Powell and Lealand. 2700 diameters.

No. 10. Water-immersion one-sixteenth, aperture 103°, by Powell and Lealand. 2700 diameters.

No. 11. Water-immersion 1-25, aperture 91°, by Powell and Lealand, 2900 diameters.

(*b*) *Photographs of* AMPHIPLEURA PELLUCIDA, *illuminated by monochromatic sunlight, with an immersion illuminator and the utmost obliquity each objective would admit without distortion.*

No. 12. Zeiss' oil-immersion one-twelfth (same as No. 1). 2830 diameters.

No. 13. Tolles' oil-immersion one-tenth (same as No. 4). 2760 diameters.

From my examination of these objectives, I am constrained to give the Zeiss one-twelfth the preference, both by lamplight and sunlight, over all the others named, and, indeed, I may add, over all the objectives I have ever yet examined.

Next comes a group embracing the oil-immersion one-tenth by Tolles, the glycerine-immersion one-sixth and one-tenth by Spencer, and the oil-immersion one-eighth by Zeiss. All these objectives perform very well indeed. When I wrote to Zeiss last January, I expressed the opinion that the performance of his one-eighth fully equalled that "of the best of the large collection of immersion objectives belonging to the Museum." But subsequent trial convinced me that my first photographic work with the Spencer's one-tenth had not done it justice, and I afterwards received the one-sixth from the same maker and the oil-immersion one-tenth by Tolles. After protracted trials, I now regard these three objectives as superior in defining power to the Zeiss one-eighth. How they compare with it, and with each other, may be fairly judged from the photographs. Of the water-immersion objectives, the Tolles one-eighteenth stands first in my estimation; the Powell and Lealand objectives next.

Among other points suggested by a study of these photographs is the fact that the superiority of the glycerine and oil-immersion objectives is not a mere consequence of their great aperture. The aperture of the one-sixth of Spencer exceeds but little, and the one-tenth not at all, that of the one-eighth of Powell and Lealand, yet their performance is much better. The aperture of the Zeiss one-twelfth is actually less than that of the Tolles one-tenth, which, however, it excels in performance, and a similar comparison may be made between the Tolles one-eighteenth and the Powell and Lealand objectives. And yet I do not doubt in the least that each additional degree of interior angle above 82° is a material advantage, provided always that the aberrations of the objective are accurately corrected; but inferiority in the formula employed or in the skill and care exercised in construction may more than neutralize the advantages that ought to be derived from this source. Nor do I doubt in the least the superiority in a general way of glycerine as the immersion fluid over water, or of oil of cedarwood and other liquids closely approximating crown glass in refraction and dispersion over glycerine. But this superiority does not occur merely because increased angle is thus rendered possible. In fact, as the angle of total reflexion from crown glass to water is rather more than 60°, it is by no means theoretically impossible to construct water-immersion objectives with angle as great as the oil-immersion objectives of Zeiss, or the glycerine-immersion objectives of Spencer. The difficulty in this case is to correct the aberrations which are inevitably produced by refraction at the upper surface of the thin glass cover and the flat surface of the objective front. These aberrations are entirely absent when the immersion fluid has the same refraction and dispersion as the glass on each side of it; are comparatively slight in the case of glycerine; much more considerable with water, and greatest in the case of the dry objectives. Professor Abbe, in the paper already cited, has drawn attention to this circumstance, which appears to me even more important than the fact that with homogeneous immersion there is no loss of light by reflexion at the front surface of the objective, and with glycerine immersion very little; but this also must have its influence.

Taking all the circumstances into consideration, I am disposed to expect further improvement in objectives in the direction of homogeneous immersion rather than glycerine immersion. In the case of homogeneous immersion, too, we have the great advantage of being able to dispense with the screw collar for cover correction, and all the deplorable loss of time entailed by the use of that contrivance, which is absolutely required in the case of glycerine and water-immersion objectives.

For this reason, in my ordinary work I give my Zeiss one-eighth the preference over the objectives I have named as somewhat surpassing them in defining power; because it gives instantly results that are not far inferior to the best I can obtain from the others with much pains and loss of time.

Finally, to illustrate the superb performance of the Zeiss one-twelfth on dry *Amphipleura*, I have added to the series a photograph (No. 14) of a very delicate frustule on a slide of *Amphipleura pellucida* from the Bridge of Allan, Scotland, mounted by my friend Professor Hamilton L. Smith, of Geneva, New York. This frustule is only 29 ten-thousandths of an inch long, and has 105 striæ to the thousandth of an inch. It is magnified 3400 diameters.

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Hints on the Preservation of Living Objects, and their Examination under the Microscope.

BY THOMAS BOLTON, F.R.M.S.

I HAVE often been asked by my correspondents how best to examine the living objects I am sending them, and also how best to keep them alive for further examination, and to watch their further growth, development, and reproduction; and I shall be glad (with the Editor's permission) to give all the information I can on these points to the best of my ability. The larger organisms, and such as are usually attached in their growth to weeds, I generally forward in glass tubes about half an inch in diameter, and two inches long; but unattached organisms, such as free-swimming rotifers, infusoria, volvoces, etc., I put in smaller tubes a third of an inch in diameter, and inch and a half long; the latter holds half a drachm of water, and the former three times as much. Of course, larger objects such as young newts, embryo fish, etc., which I occasionally send out require larger tubes or bottles, which entail much extra care in package to allow for the much greater danger of breakage and leakage.

When such tubes as I have described are received by post they should be opened, uncorked, and, if they cannot be examined at once in the microscope, it is well to take a bung cork with a hole bored in by a cork borer to fit tumbler. Pass the tube into the hole so that the top is level with the top of the cork, and so float the tube and its contents on the surface of water in a tumbler, basin, or still better, in an aquarium. In this way much danger to the life of the more delicate animal organisms will be avoided from variations of temperature, which are not unlikely to occur in so small a body of water as the tubes themselves contain. In this way many of the advantages of a large body of water is obtained without any danger of the objects being lost, or diffused over too large a field to be readily found again.

EXAMINATION OF OBJECTS ATTACHED TO WEEDS AND ROOT FIBRES, SUCH AS POLYZOA, HYDRA, TUBE-DWELLING ROTIFERS, VORTICELLIDÆ, ETC.

Examine the contents of the glass tube with a pocket lens of about 2 in. focus. The tube case of a Melicerta ringens would be readily seen like a little black thorn standing erect from the surface of the leaves of the anacharis, myriophyllum, or other weed, and often attains the length of a tenth of an inch. If the tube be examined in the front of a window and held a little sideways so that the direct light of the window does not enter the eye, a little higher power of lens, such as Browning's platyscopic lens, will reveal the beautiful red color of the tube in fine contrast with the bluish hyaline ciliatory wreath, apparently whirled round its mouth in rapid gyrations. Many other organisms may be readily detected, and some of their beauties guessed at in this way, and a little practice will soon enable the student to recognise most of the larger and many of the more minute organisms, or, which is perhaps more important, see that there is something he does not recognise, and which will require the use of the compound microscope to bring out the details and reveal its nature.

If the objects are attached to such a weed as the anacharis, after noting under the pocket lens, as above, the position of the several specimens on the weed, it will be best to transfer the weed by a pair of forceps from the tube to a zoophyte trough (about 2½in. long, 1½in. high, ⅜in. thick or deep), into which the water from the tube is poured, together with sufficient soft or tap water to nearly fill it. Examine again with pocket lens, and adjust the weed into a suitable position for the examination of some one or more of the specimens.

Place the trough, if convenient, at once in the microscope, and let it remain some hours at rest, and doubtless, if not before, it will now be seen to advantage.

In this position it may with advantage be examined with low powers, such as the 3in., 1½, and ⅔, and possibly occasionally, when it is peculiarly well placed, with the 4-10ths objective.

In such a trough it may be expected to live a week or so without change of water, or it may be kept longer in a small saucer, or evaporating dish, or still better in a fresh-water aquarium, in which the individual would very likely propagate and increase.

The student should carefully examine the whole of the weed under the low powers in the trough, and it is very likely he will be repaid by seeing some younger individuals just commencing the building of their tube, and he may possibly find others in a still earlier state swimming or creeping amongst the leaves.

For examination of the Melicerta under the ⅔, 4-10th, and ¼in. powers, it may be advantageously placed in a slide trough or tube cell of about 1-6th of an inch or less, covered with thin glass. To do this an individual should be noted on the weed, conveniently placed on a leaf, or, still better, on the stem. With a small pair of nail-scissors, the leaf on which the individual is placed should be cut off the weed, leaving a small piece of the stem attached, and so transferred to the trough or cell. It may sometimes be necessary, with the scissors, to pare down or split the leaf carefully without injuring the specimens, so as reduce the leaf to a less width than the depth of the trough or cell. This being done, the leaf can be placed in the trough or cell sideways, and the piece of stem attached to it retains it in that position, otherwise the Melicerta tube, which is generally built in a position standing up from the surface of the leaf, would not be conveniently placed for examination.

This manipulation may be very conveniently carried on in a deep watch-glass, under a dissecting microscope.

If a slide trough or tube cell be not at hand, the individual so selected may be placed in the ordinary animalcule cage or compresser, and for the highest powers this arrangement is best.

The slide trough arrangement has a great advantage in having the object in a more natural position, and in which it will live the longer. Moreover, when not wanted for examination under the microscope, it may conveniently be transferred to a basin of river water, or still better, suspended in an aquarium. In this way an individual may be kept alive for some time, and its life-history watched, and possibly young ones may be propagated and attach themselves to the weed or even to the glass.

When the Melicerta is found on myriophyllum, it cannot be better exhibited than by taking a single leaf, placing it on a slip of glass (with ledge) with a little water, cutting off any little fibre of the leaf which might interfere with the examination of the specimens, and then covering them with glass.

In this way it can be viewed with the highest powers, and can be beautifully illuminated with the centrally-stopped parabolic reflector, or with the spot-lens.

The student will find that individuals grown in confinement build their tubes of much more transparent materials, and therefore are much better adapted for examination.

The previous directions, although especially applicable to Melicerta and tube-forming rotifers, are applicable to all organisms living attached to weeds. I will next point out the best ways of examining the free-swimming rotifers and infusoria, and afterwards different manipulations applicable to both.—*English Mechanic.*

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— J. M. Eder has found that the best material for killing insects without injuring their color, hair or scales, is bisulphide of carbon.

Notes on the Pygidia and Cerci of Insects.

BY HENRY DAVIS, F.R.M.S.

SOME years ago most microscopists quoted the pygidium of a flea as being one of the best of definition tests, and although doubtless it is now well known as being so variable, that for comparative trials (where objectives are not tested on the same specimen) it is practically of little value; still its delicate beauty, the puzzle as to its function, and the fact of its being generally considered as an organ unique amongst insects, keep it to the present day as an object of abiding interest, and one without which no cabinet would be called complete.

As one of its early admirers, I gave it, some years ago, considerable attention, and was able not only to convince myself that the angular, square-shouldered outline of the rays in the areola, thus figured in the 'Micrographic Dictionary,' has no foundation in fact, but that those areolæ possess some outer structure which seems hitherto to have escaped notice. It has afforded me a somewhat malicious pleasure in challenging those of my friends who used high modern powers, to discover this structure for themselves. They invariably failed. A small-angled ¼-inch objective, fully twenty years old, first showed that, looking on an areola as representing a carriage wheel, a line proceeds outwards from the tire between each spoke, and these lines being bounded by a circle, give resemblance to a wheel within a wheel: the new wheel or circular band is, when the object is unflattened by pressure, at right angles to the plane of the inner wheel; the first forming the sides, and the latter the bottom of a little pit, from the centre of which springs the well-known fine long hair.

This is not brought forward for the purpose of glorifying old objectives, or decrying the power, optical and manipulatory, of certain microscopists, but rather to show the advantage of mounting one's own preparations; for the structure can only be well made out when the object is placed in a position which a professional mounter would endeavor to avoid and consider as wrong side out.

Until 1870, when Mr. Peake discovered a pair of pygidia on the Lace-wing fly (*Chrysopa peola*), the Flea appears to have been the only insect known to possess this appendage, and, after diligent inquiry, I cannot find that since that date any published addition has been made to the number. But in December, 1870, it was my fortune to notice two pygidia on a fine Locust (*Locusta migratoria*) I had captured near Cadiz, and after finding these the road was made to very many discoveries in other, mostly allied, insects. It will be a safe, because an under, statement to say, that without any special search, fifty insects of different species are now proved to possess pygidia. The organ is here spoken of in the plural, as with the single exception furnished by *Pulex*, all the insects examined have it in pairs more or less separated; even in the Flea it is distinctly double and bilateral, and I submit it should no longer receive the singular appellation except when divided.

It would doubtless be satisfactory to give a full list of all the insects on which I have found pygidia, but it happens that by far the greater number are exotic, taken, some at the Cape of Good Hope, some in Mauritus, and other places abroad; the correct naming is a difficult task; even Mr. Frederick Smith, of the British Museum, shrank from it, and I am constrained to speak of the foreign species in general terms, but will give particular examples in common English insects.

The pygidia of the Lace-wing may be taken first, as introductory to a series gradually increasing in size; they are found as nearly circular, flat, or slightly convex plates, one on each side of the last (posterior) joint of the abdomen; they are dorsal, and only require to be pushed (so to speak) closer together to be exact copies of the pygidia of the Flea. It has a similar collection of the same shaped areolæ and the same characteristic fine long central hair. Next to this, as having pygidia of the nearest resemblance to that of the Lace-wing, comes the common small grasshopper (*Gryllus*); in this the organs project slightly, conical in figure and somewhat flattened at the sides, but otherwise they are exactly similar to the only pygidia hitherto known. In the large grasshopper (*Acrida viridissima*) the parts are much longer and not easily overlooked, while in the Cricket (*Acheta domestica*) we find these same organs extended to an immense length—sometimes three quarters of an inch—but still bearing the peculiar structure of rayed and haired areolæ. The Mole. Cricket (*Gryllotalpa vulgaris*) also has large and beautifully marked pygidia.

In the Cock-roach (*Blatta Orientalis*) may be found correspoding large appendages, which are called *cerci* by Burmeister; except in position, there is little at a glance to identify them with the parts we have seen. They are nearly bare on the superior surface, and the under side, often turned upwards and outwards, only is furnished with any long hairs; nor are these set in broad, deep sockets like those described, but are attached to small, clear, unrayed spaces, flush with the chitinous integument. To found a belief that these cerci are really pygidia, it requires considerable aquaintance with the latter's various modifications, and, above all, a knowledge of the very peculiar properties of the long hairs to be mentioned presently.

Of foreign insects having pygidia, I purpose saying little, although they have supplied the greatest number and variety of examples. Among these it really would seem as if all the orthopterous insects have them, and most of the Neuroptera. Some are very minute, even when the owner is of large size; others greatly elongated, as in *Lucina opilioides*, where the organ is over an inch long. Curious instances may be found in *Thuzalis*, in *Heterodes;* also in an Indian Grasshopper (possibly anonymous), which has the organ twisted, and tipped with a hard serrated hook.

As regards the function of pygidia, it might appear, at first sight, that the new examples being mostly of large size, there would be little difficulty in investigating and determining a matter which, in the case of Pulex, has vainly taxed the skill, patience, and acumen of many excellent observers; and probably if the subject were taken up again by biologists well versed in the anatomy and physiology of insects, satisfactory results might accrue; but as a matter of fact, the inquiry is by no means an easy one, and after considerable study of fine and various specimens, I, for a long time, only arrived at a conclusion—an old one, it would seem, of the late Mr. Richard Beck—that pygidia are collections of tactile hairs forming posterior feelers; but quite lately, almost by an accident, I was enabled to see that, while they may be this, they certainly are something, and very much, more.

I had a pygidium of a Cricket under a low power, and was surprised to see a strong, waving motion in the hairs; this, at first, was attributed to action imparted at the will of the insect, although it was at the time stupefied and quieted with chloroform; but the same sort of movement occurred when the creature was quite dead, and when only a thin section of the organ was under the microscope. It was found that the hairs are so light and so delicately attached, that the ordinary breathing of the observer, at fully ten inches distance, set them in motion; and a slight movement of the hand a foot or more away caused a visible disturbance, which is not a mere vibration, but a rocking of the motile hair in its socket, and of the disk by which it is attached. In repeating this experiment, it is necessary to examine the part within a short time of the death of the insect, and before the *rigor mortis* has set in; otherwise the little disk at the base of the hair (sometimes there is a rounded end, but never a root) will become more or less firmly fastened to the white (nervous?) matter in which it seems set, and the hair will be found comparatively insensitive.

It will be seen that as mere tactile hairs they are far too delicate; moreover, examples may be found in some species of Lace-wing, and notably in the Flea of the Pigeon, where by being surrounded by coarse true hairs, or placed under stout curved spines, they are partly or wholly protected from contact with external bodies. I am led to believe pygidia to be collections of motile hairs, forming organs of feeling induced by the movement of the air in their neighborhood; not perhaps, an organ of a new sense between touch and hearing, but of feeling not excited in the ordinary way by actual touch. I apprehend that any insect having pygidia must infallibly be warned of the approach, however stealthy, of an enemy; even if, from its position behind the insect, that enemy could not be seen, the warning being given by the moving hairs actuated by the disturbance of the surrounding air.

In these notes I think may be found reasons for discarding the use of the word "cerci," as applied to all those insect organs which are plainly modified forms of the better known "pygidia." The latter simply meaning something on the *uropigium* will permit them to be of any form or size; and as "cerci" means tails, it is absurd to apply it to objects of no length, as the pygidia of *Chrysopa* and *Pulex*. But if these be tails, then indeed man himself has one.—*Journal Royal Microscopical Society.*

Argulus Lepidostei.

BY PROF. D. S. KELLICOTT, BUFFALO, N. Y.

AT page 1 of volume III of this journal, is a description with figures of *A. Lepidostei*, reprinted from the "Bulletin of the Society of Natural Sciences" of Buffalo. All the specimens taken previous to the publication of the paper were females. None were secured in 1877 or 1878, but this present Autumn the *gars* are again taken plentifully along our river, and I have obtained both sexes of the parasite. I am now able to present some additional notes upon the species, and an account of the male, and its differences from the female.

I begin by correcting an error in the

first paper. I called the second antennæ five-jointed. This because the first or basal joint is elbowed and constricted at the elbow (shown at a^2, Fig. 2); but this feature has entirely disappeared from an antenna mounted in liquid; this, and the absence of setæ at the supposed articulation, and also a comparison with other species, leads me to conclude that it is four-jointed, agreeing with this character of the genus as established.

The first pair of antennæ have an auxiliary two-jointed part not mentioned in the original paper. It issues from the upper surface of the second or uncinate joint; it has the basal joint long and slightly curved, the terminal one short, ending with setæ; the whole reaches somewhat beyond the hooked part from which it arises. I prefer to regard the first antennæ as four-jointed, this extra organ being the third and fourth.

I find the parasite frequently on the fins and upon the head.

The male has the same general form as the female, the carapax, however, is shorter, reaching barely to the third natatores instead of covering them. The abdomen differs considerably in outline, it being hastate. The "cultriform appendages" (Dana) to the last pair of legs have the same form as in the female, reaching further beyond the border of the abdomen. These are not correctly represented in Fig. 1, *h*, as they curve forwards and have heel-like prominences at their base.

In the place of the elliptical brown bodies in the female abdominal lobes, are two very large brown bodies or sacs, shaped like an "Indian club"; they occupy fully two-thirds of the area of the lobes. The color is due to granular contents of the sac and to irregular spots of pigment over the surface. These bodies are now regarded as the testicles (Siebold's Comp. Anatomy, page 357, note by the editor).

In the thorax, opposite the insertion of the second and third natatores, lying exactly in the notch of the carapace, is a large urn-shaped brown body with a prolongation from either side extending to and apparently uniting with bodies situated on either side of the alimentary canal in the last thoracic segment. This body is situated below the dorsal vessel, and above the intestine. It often exhibits peristaltic motion, and is evidently sexual. This brown spot and those of the "caudal fin" enable one to easily detect the males.

The accessory male organs occupy the terminal joints of the last two pairs of swimming legs and the middle joint of second. On the front border of the fourth pair is a truncated narrow stylet, surmounting a robust chitinous base. It is directed forwards, and was regarded by Jurin as the penis. It appears that in most species it is a stout recurved hook. Opposite this, on the posterior margin of the third pair, is a deep socket or cavity into which the stylet and its robust base may be thrust. On the anterior border of the same is a cushion-like body which plays against the appendage of the second pair of natatores. This organ is shaped like a ploughshare of the coulter sort. The coulter part is horizontal with the cutting edge directed outwards, the curved or inner edge is serrate, the cushion above mentioned playing over its curved or mould-board surface (under surface).

The size of the male, as in other species of this genus, is less than the female. I measure a mature one as follows: length, ·28 of an inch; width of carapax, ·15 of an inch.

The color is quite as deep as that of the female, being a yellow green.

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In re Apertometers.

THE great increase in the angular aperture of modern objectives, has compelled the invention of more efficient means of estimating this than the old measurement in air by means of the sector would allow.

In 1873, Mr. Tolles, urged by the necessity of devising some apparatus by which a greater balsam angle than 82° could be demonstrated as passing through an objective, constructed the now well-known semi-cylinder of crown glass, in which the course of any ray of light, passing through it, can be seen and readily measured.

After Mr. Tolles came Prof. Abbe, of Jena, with his apertometer, then Prof. H. L. Smith with his Universal ditto, and last, but not least in its complete arrangement, has appeared that of Dr. Woodward.

All of these instruments, except the Abbe one, are constructed upon the sector principle, modified by the condition of passing the light through crown glass, that is, they all measure directly the angular distance of the extremest pencil of light that can be passed through an objective, that is carefully focussed to show an image of some object in *front* of the objective; while the latter—the Abbe—measures the angular extent of the diminished picture of surrounding objects, which is seen and estimated, behind the objective, whose aperture is to be ascertained.

This can be readily seen and measured, in the case of a low power, an inch or below, without any extra appliance, but, in measuring the angle of higher powers, the picture is, in proportion to the magnification, so much reduced in size as to require for its observation the use of an auxilliary objective of low power attached to the draw-tube, which, with the eye-piece, is used as a telescope.

The principle on which this construction is founded can be very easily verified by holding a low power objective a short distance from the surface of a tube brightly lighted, when, with a little experimenting, a minute picture of the objects upon its surface will be perceived, the angular extent of which will be exactly limited by the angular aperture of the objective.

The Abbe instrument is a semi-elliptic disk of crown glass, its long diameter 9 cm., (3·6 inches); its short 8 cm., (3·2 inches); and 13 mm. (0·5 inch) in thickness, with its semi-circumference ground and polished at a right angle to its plane surface, and its long diameter worked at an angle of 45° to its upper plane surface, by which inclination all rays reaching it through the front are totally reflected at a right angle to their former direction. In the centre of the ellipse is cemented a small disk of silvered glass centrally pierced by a hole of about 1-30 inch in diameter, through which the light is transmitted to the objective to be measured.

On the upper plane surface of the disk two scales are engraved. The inner one showing the air angle of an objective—up to 166°—by direct inspection, no computation being necessary. The outer scale shows what Prof. Abbe calls the numerical aperture, in which the figures and marks indicate the product of the sine of the semi-aperture of the objective by the index of refraction of the medium in which it is examined; and is constant for all media.

It is therefore only necessary to divide the half sum of the figures indicated by the blackened brass points which, sliding on the front surface, show the angular extent of the pictures, by the index of refraction of any medium, to obtain the semi-angle for that medium.

This process necessitates the use of logarithmic tables, and as these may not always be at hand, I have thought it might be well to append to this paper a computation I had made for my own use, as a time saver, of the balsam angles equivalent to every fourth of a division of the outer scale from 1·0 to 1·35, i.e., from 83°30′ to 128° angle in balsam, assuming that the refraction indices of crown glass and balsam are identical, which is not strictly accurate, though practically, perhaps, it may be thought sufficiently exact. I have taken the index of crown glass to be, as given by Wollaston, Ganot and others, 1·50.

I think the instrument would and easily could have been improved by having the spaces more closely marked, especially in the higher degrees, though there is certainly no great difficulty in measuring the interspaces with the eye, aided by a moderate magnifier.

This disk can be used upon the level stage of any microscope. The central spot may be roughly focussed by the objective to be examined. If immersion, a drop of fluid will be needed on the front of the objective, and the extent of the picture having been ascertained by the indices, which are sharply to be seen on the margin of the picture, it only remains to find one-half the sum of the indications on both sides of the disk, and we have ascertained the numerical aperture from which the balsam angle may be found by computation or from the table.

Accurate centering or focussing is not necessary, as the deficiency of either side is balanced by the excess of the other, and whether the little hole is exactly in the centre or not is a matter of indifference.

The strictures made by Mr. Wenham, in his paper, on "Prof. H. L. Smith's Apertometer," in the last number of the *American Quarterly Microscopical Journal*, upon the Abbe instrument—that the use of high eye-pieces affected unfavorably the results of an observation by it, and, therefore, that the instrument was quite unreliable—are, by his own showing, not warranted by the facts; for as one would never have occasion to use anything but the lowest eye-piece, and as he admits that it certainly did show what was claimed for it by that, it is difficult to see how the reliability of the instrument can be in any way affected by the effect of the high eye-pieces.

This argument would apply with equal force to the instrument of Dr. Woodward, or any other used telescopically. As to the length of the tube that will alway be determined by the length of focus of the low power auxilliary objective, and that of the draw-tube to which it is attached when the indices are sharply in focus.

In thus describing the Abbe instrument, I wish it to be distinctly understood that I do not think that the performance of either of the other instruments alluded to can in any way be objected to, but is, on the contrary, quite satisfactory. Yet, for their accurate use they require separate and costly adaptations. While the Abbe, wholly unlike them all in the principles on which its action is based, simply requires an ordinary stand with a clear stage, and a draw-tube for its satisfactory use.

The angles of aperture indicated by the respective marks on the outer scale of Prof. Abbe's Apertometer, calculated at a refractive index for crown glass of 1·50, are as follows:

1·	83° 30′
1·012	85°
1·025	86°
1·037	87° 30′
1·05	89°
1·06	90°
1·075	91° 30′
1·087	93°
1·1	94° 30′
1·112	96°
1·125	97°
1·137	98° 30′
1·15	100°
1·162	101° 30′
1·175	103°
1.187	104° 30′
1·2	106° 30′
1·212	108°
1·225	109° 30′
1 237	111°
1·25	113°
1·262	114° 30′
1·275	116° 30′
1·287	118°
1·3	120°
1·312	122°
1·325	124°
1·337	126°
1·35	128°

Fifteen minutes or over, called 30′.
Forty-five " " " 1°.

L. M. Willis.

No 1 Dexter Row, Charlestown, Mass.

The Preparation and Mounting of Double Stainings.*

BY C. C. MERRIMAN.

THERE is no art of the microscopist more beautiful and interesting than that of bleaching and recoloring vegetable tissues. In no other way can the wonderful process of plant growth be made manifest under the microscope. Therefore any suggestions tending to simplify the art, and make it more generally practicable, will be of interest to all workers in microscopic preparations.

In my experiments with double staining I have found that different colors, or at least different pigments, vary greatly in the activity, or penetrating power, with which they affect vegetable substances. Thus, an object prepared for staining may be left in a strong solution of carmine for a day without having all its parts colored; whereas in a logwood or aniline dye of equal strength it would be colored perfectly opaque in less than an hour.

By taking advantage of this fact, and immersing objects first in the color having the slowest action, then in another of greater activity, and so on, double, or even multiple, staining becomes an easy and simple process, instead of the very difficult and complicated one which has been published in our magazines.

I will give the general details of the operation as I have now practiced it for some little time. I do no not claim that exactly the same formula will answer for all kinds of plant specimens, or that all the colors given below should be used in all classes. I merely give a general formula, which each operator will find it necessary to vary somewhat, according to the results of his experimenting. If I succeed in stimulating others to more detailed work, by showing how simple the process is in most cases, I will have accomplished my purpose.

All vegetable preparations, whether parts of leaves or sections of stems, should first be fully decolorized in the common chlorinated soda solution, sold by all druggists as a disinfectant. This result will be accomplished in most cases in about one day. Then, after being thoroughly washed in pure water, the preparations should be placed in a solution of carmine of about the consistence of common carmine ink; and they may remain in this for a day. Pure carmine will readily dissolve in water with a few drops of aqua ammonia in it.

After being washed in two or three changes of pure water, the objects may now be placed in a somewhat weaker solution of extract of logwood in alum water. A small quantity of alum in the water is sufficient to effect, at least with the aid of heat, the solution of the logwood. This should be filtered, not old at the time of use, and of a strength not more than half that of common writing ink. In this solution the objects may remain from fifteen to thirty minutes according to the delicacy of the specimens. If the color should appear to be too deep or opaque, it may be partly removed by soaking in pure alum water.

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*Read before the American Society of Microscopists at their meeting at Buffalo, N. Y., Aug. 19th, 1879.

Then, after washing again in several waters to remove all trace of the alum, place the objects in alcohol for a short time, and then into a weak solution of aniline blue in alcohol. In this they may remain an hour or two, or until all the parts not previously stained are colored blue. If on trial the color should appear to be too deep, it may be partially removed by soaking for a time in pure alcohol.

It sometimes happens that even aniline-blue will not color all the parts of vegetable substances, such as large glandular or stellate hairs. In this case an immersion for a minute or two in a very weak solution of aniline-green in alcohol will accomplish the work. Green is the most powerfully absorbent-color that I know of; and should be used with caution, as it would soon spoil a staining.

From alcohol the objects may be removed directly to turpentine. I do not like the action of oil of cloves. It shrivels up tender tissues, and gives them the appearance of being burned. Besides it is not necessary as an intermediary between alcohol and turpentine. After a day's immersion in turpentine the preparations will be ready for mounting in Canada balsam.

Vegetable preparations have quite an appreciable thickness, and unless some special care is taken of them after being mounted in balsam, it will be found that air will quite often work in under the cover. Therefore, as soon as a balsam mounting is dry enough to have the superfluous balsam cleaned off, with the point of a knife, around the thin glass cover, which will be in two or three days, especially if aided by heat, a light coating of shellac cement, colored with aniline blue or red (not green or yellow), can be spread with a camel's hair brush around the edge of the cover, and the next day another coating, and perhaps the third day another still. In this way the cover will soon be firmly set and can be cleaned; and the slide is a permanent mounting in much shorter time than if left simply for the balsam to dry hard—and there is no risk of air working in from the drying of the balsam.

Canada balsam is by far the best and safest medium in which to mount all stained preparations that will bear this mounting. But there are many, such as those with delicate hairs or glands, or with fine cellular markings, that will not show to advantage in so refractive a medium as balsam. These may be removed from alcohol into water containing three or four drops of carbolic acid to the ounce of water. It will be necessary also to mount them in the same fluid in cells.

Well-dried shellac cells may be used; and if the tops are made perfectly level by holding a bit of fine sandpaper on them while being turned on the turntable, the thin glass cover will fit closely, pressing out the superfluous water which can be taken up with a camel's hair brush. When well dried in this way, a little gold size can be applied to the edges with perfect safety against its running in.

A very simple and almost universally applicable cell I have recently made in the following manner: My friend Wm.

Struter, foreman in the works of Sargent & Greenleaf, of Rochester, makes a neat little double punch for the purpose of cutting out narrow circles from the thin colored sheets of wax used by artificial flower-makers. Either single, double, or three-folded sheets can be used, according to the thickness of cell that may be desired. These circles may be fastened on the slide, either by shellac cement or by simply warming the slide. These cover all the cell, both inside and out, a coating of gold size, or of marine glue dissolved in coal naphtha, must be spread with camel's hair brush. When this is dry we have a cell beautifully colored, and proof against all the fluid media, which one may have occasion to use in mounting. Besides the cell is always soft enough to have the thin glass-cover pressed into perfect contact with it all around, which is the great requisite in all fluid mountings. It should afterwards be finished on the outside with Brunswick black or shellac cement to form a firm support to the thin glass-cover.

Photography as an Aid to Microscopical Investigations.*

BY DR. CARL SEILER.

WE all doubtless appreciate the necessity of correctly recording, not only in writing, but also by means of pictures or drawings, many of the appearances seen in the field of the microscope. We can do this by drawing an outline of the objects seen by the aid of the camera lucida, but not only does it require some practice, but also a considerable amount of time, and even then the resulting picture will not be a correct representation of the field of the microscope, because it will always be tinged more or less by the imagination of the draughtsman, and will be more or less diagramatical in consequence. With photography, on the other hand, an exact reproduction of the images thrown upon the screen can be obtained, and in much less time than it takes to make even a comparatively simple drawing with the camera lucida.

It is the purpose of this paper to give an idea as to the means employed to obtain a photographic picture of a microscopic object; means which are in the hands of every microscopist, and which do not require a great outlay of money.

A room with a Southern exposure, which can be darkened, a mirror movable in all directions outside of the window, achromatic combination of lenses of from 8 to 10 inches focal length, a microscope which can be tilted so as to be horizontal, and a stand to hold the screen and sensitive plate are all the apparatus absolutely necessary, beside the chemicals used in ordinary photography. These different pieces are disposed of as follows: The mirror, which should be 8 or 10 inches long, and about 4 inches wide, is attached to a board which fits into an opening in the shutter of the Southern window and is to be moved by rods from the inside.

Instead of the mirror, or in conjunction with it, a heliostat is of great advantage to throw the light of the sun constantly in one direction, for if once adjusted it need not be disturbed, and thus a great deal of time is saved. Until recently such an instrument was too costly for the use of the majority of students, but of late Mr. Kubler, of Washington, D. C., has put a heliostat in the market which works very satisfactorily, and which is sufficiently low in price to be within reach of many who desire to work in micro-photography.

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*Read before the American Society of Microscopists at their Meeting in Buffalo, N. Y., Aug. 19, 1879.

This board has in its centre a circular opening containing the achromatic combination of lenses, such as a back combination of a ¼ portrait photographic lens. The microscope is then tilted until its tube is horizontal and is secured on the window-sill in a line with the axis of the achromatic combination, and at such a distance from it that the burning focus is about half an inch from the back combination of the achromatic condensers. The eye-piece is then removed from the microscope, and the tube lined with a tube of black velvet to prevent internal reflection as much as possible, and the whole apparatus is covered with some dark cloth, so as to prevent stray rays of light entering the darkened room any other way than through the microscope. This done, the sun's rays are reflected from the mirror outside through the achromatic combination, which acts as a concentrator, and throws a powerful light through the condenser, through the object on the stage, and thus a brightly illuminated image is formed by the objective on the screen, which, when the negative is to be made, is substituted by the sensitive plate.

This image, when thus formed, must be focussed with the greatest care and accuracy in order to obtain a sharp negative, and as the screen must be at some distance from the microscope, in order to obtain the necessary magnification of the object, it is necessary to have some contrivance for turning the fine adjustment at a distance. For this purpose it will be found that a small pulley placed alongside of the microscope, having an endless band running over it and the mill head of the fine adjustment, answers the purpose very well when the axle of the pulley is connected by means of a universal joint to a fishing rod, which by its sections can be made longer and shorter, thus bringing it close to the screen.

The tube of the microscope, even when all internal reflection has been obliterated, still remains a drawback inasmuch as it reduces the size of the image, or rather of the disk of light, the longer it is. There are, however, some stands made in which the tube can be entirely removed, such as the old Ross stand, and Powell and Lealand's great stand, and these are, therefore, very desirable for photo-micrographic purposes.

The stand should also be provided with a mechanical stage, as without it a great deal of time is lost in selecting the proper field to be photographed, and an achromatic condenser provided with centering adjustment is absolutely necessary for the proper illumination of the object. *Any good* objective may be used with success in this work, but one of wide angle is preferable. In my own limited experience, I have not found any advantage in objectives specially constructed for photography over other good objectives, provided monochromatic light is used, which brings the visual and the chemical focus in the same plane.

Such a light is obtained by passing the rays of the sun through a cell containing a strong solution of ammonio-sulphate of copper before they enter the sub-stage condenser. I have found some difficulty in making a cell containing this solution, as the copper salt will dissolve almost any cement, and if exposed to the action of the air very rapidly becomes decomposed and turbid. In my hand is a cell made of a brass ring lined on the inner side with lead, and having a thread cut on its outside, to which flanged rings are screwed. Upon the edges of the inner ring a ring of rubber packing is applied, and upon it a disk of plate glass is laid, which is tightly pressed upon the rubber by the flanged ring. Thus a cell is obtained very similar to the round flat spirit-level, and which will hold the ammonio-sulphate of copper solution for months without change. In filling the cell care should be taken to leave room for a small air bubble, for if the cell is completely filled, the heat of the sun's rays will expand the solution sufficiently to cause leakage.

This ammonio-sulphate of copper solution, beside giving monochromatic light, at the same time filters out almost all the heat rays from the light, so much so that an immersion lens may be used for almost any length of time without the drop of water evaporating.

At the present time, when dry-plate photography has been developed to such an extent that it has superseded in a great measure the old wet process, it is thought that it would be the most simple, economical, and satisfactory process for photo-microscopy; but after repeated trials by myself, as well as by others, working in the same direction, it was found that it is not only more expensive, but also takes more time in the long run. The reason of this is, that it is impossible to judge with any degree of certainty as to the actinic power of the light forming the image on the screen by merely looking at it, and that a trial plate only will give an idea as to the length of exposure of the plate for a given day, time of day, and subject to be photographed. It is true we can expose a dry plate for trial, but then we must develop it immediately, and the time it takes to develop a dry plate is about three times that of developing a wet plate, and a dry plate is also about three times as costly as a wet one. Therefore, the old wet process is the best.

The collodion should be an old one, containing some free iodine, and I have found that a mixture of "Anthony's red-labeled" and "McCollins's delicate half tone" collodions, some five to six months old, gives very satisfactory results. The nitrate bath should contain 40 grs. of nitrate of silver to the ounce of water, and should be slightly acid with nitric acid, and the developer should be a weak iron developer, 12 to 15 grs. of ammonio-sulphate of iron to the ounce, containing a few drops of a solution of gelatine in acetic acid as a restrainer. After the negative has been fixed with hyposulphite of soda or cyanide of potash, it is almost always necessary to intensify it, which is most easily done by flowing the plate while wet with a watery solution of iodine until the film becomes white, then the plate is washed thoroughly under the tap and flowed with a weak solution of sulphide of ammonium, which gives it a dark-brown color and thus strengthens the negative.

The object to be photographed should be as thin as possible, because the lens will depict only one plane of it, and it should present as much contrast and differentiation of its elements as possible. This is especially the case in animal tissues and when high powers are used, and the focus should be taken for one particular point to be brought out with the greatest care, a general focus not particularly sharp in any one point will not give a satisfactory negative.

The screen upon which the image is procured should be of plate glass, having an extremely fine ground surface on one side, the side next to the object. Such a surface can be easily prepared by flowing the glass plate with good negative varnish, and when this is set, but not yet dry, by lightly breathing on it, when an extremely thin and even frosting of the surface will show itself, sufficient to arrest and reflect the rays of light forming the image.

The focus may also be taken on a piece of plate glass without any ground surfaces, by means of a focussing lens which has been adjusted accurately, and this method, although more tedious, gives better results. In that case the image is first thrown upon a piece of white card-board and the particular spot to be photographed is thus selected, and then the plate glass is substituted for the card-board.

The greatest difficulty encountered in photographing microscopic objects is the illumination, which must be handled with the greatest care so as to avoid diffraction.

As a general rule the best light is obtained when the back lens of the sub-stage condenser is about half an inch beyond the burning focus of the larger condenser in the shutter, that is about 8½ inches from this condenser, and when the light is absolutely central. But this distance cannot be strictly adhered to, inasmuch as different objectives require different illumination. In practice I find that in order to get the proper distances for the condenser for a particular objective, it is best to put a blood slide, upon which the blood corpuscles lie in one layer only, on the stage, and project the image on the screen, moving the condenser back and forward, until, when sharply focussed, no concentric rings are seen in the discs. The object to be photographed can then be substituted for the blood slide, and the light will be found to be all that is desired.

When large objects, such as whole insects, are to be photographed under low powers of low angular aperture, such as for instance with Zentmayer's 3, 4, or 5 inch objective, the mode of illumination must be somewhat altered, so as to obtain an evenly illuminated field on the screen. Under such circumstances, it is necessary to remove the sub-stage condenser from the microscope, and substitute for it a plano-convex lens of some 3 or 4 inch focus placed close to the object. The instrument must then be moved close to the large condenser in the dark shutter, where it will be found that objects as large as three-fourths of an inch in diameter are evenly illuminated.

On an Improved Microscope Illuminator for Diatoms and other Test Objects.

BY F. H. WENHAM.

I HAVE appeared so frequently on this subject, that I need some excuse for coming forward again. The contrivance that I have to describe is simple, easy to construct, and so effectually answers its purpose, without any difficulty in use, that I consider it worthy of record.

With regard to illuminators in general for the microscope, the idea has long been exploded that it is at all necessary to use achromatic lenses having but little spherical aberration; lenticular arrangements uncorrected for chromatism act quite as well—in fact, some of the best effects that I have seen have been by the chromatic bands of ordinary lenses—and for the purpose of intensity, mere condensation, irrespective of any image-forming focus, is quite sufficient. The requirement is to obtain readily rays at a great obliquity. Formerly there was supposed to be a difficulty in effecting this, as a cone of rays does not pass the under surface of a glass slide on to a balsam-mounted object at an angle beyond 82°.

In order to cause rays to enter above this critical angle, it is necessary to obtain optical continuity between the illuminator and under surface of the object-slide. To effect this I introduced and described in a paper read before the Microscopical Society in March, 1856, several forms of immersion illuminators. The first was a right-angled prism connected with the slide by an intermedium of oil, turpentine, or oil of cloves, the last having nearly the same refractive index as crown glass : *a* is the prism, *b*, object-slide and cover under which the objects are mounted in balsam. Rays of light (as shown by the dotted lines), if sent through the face of the prism, pass straight to the upper surface of the cover, and totally reflected down again on to the underlying objects in balsam, which appear brilliantly illuminated as if beneath a speculum, under the curious condition that with a dry or non-immersion object-glass they may be viewed as opaque objects without impediment, even if the objective works quite close to the cover. A wet or immersion object-glass prevents the covering glass from acting as a speculum, and light emerges beyond 82° and enters therein, thus with glasses of large aperture resolving the striæ on the most difficult tests.

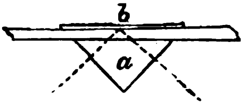


Fig. 1.

If the immersion object-glass is used on dry-mounted objects, their total reflection, instead of occurring from the cover, takes place from the upper surface of the slide itself, and all would be total obscurity; but if lepidopterous scales or diatoms are mounted on the slide, any portion of them in intimate contact therewith prevents total reflection at the part, and light is transmitted through the adherent points, rendering them curiously distinct in a jet-black field. Precisely this arrangement has been claimed and made better known as the "Woodward prism." It has the fault of requiring the addition of some extraneous means of condensing and intensifying the light, as shown in my paper of 1856; for this reason I adapted and figured a lens nearly hemispherical, connected with the slide by oil of cloves, in the same way as the prism. This lens gives more light, is in every way preferable, and is now in common use. As the light is partial and one sided, in the same paper I figured and described a truncated paraboloid of solid glass, the focal distance falling above the polished flap-top, so that when a glass object-slide was laid on with the oil the focus should be at a point distant the thickness of the slide.

In the year 1872, Dr. Barker, of Dublin, regardless of expense, caused a number of these paraboloids to be constructed of various foci and sizes (of course the size is determined by the focus) in order to ascertain which would give the best effect. It is right to mention that they were made by workmen coming under my own observation, and I had the privilege of first seeing the results. The best form was advertised by an independent maker under Dr. Barker's name. Notwithstanding this, the instrument has recently again been claimed with a flourish of trumpets as the "Edmund immersion paraboloid." Papers on the instrument were read before the Royal Microscopical Society and Quekett Club, even appropriating my own description of the effects, with an assurance surprising, considering that anyone present at all conversant with geometrical figures might have asserted that a paraboloid truncated a little below the focus could be no other than a paraboloid with a flat top. This would-be inventor writes: "I need only to observe that the paraboloid described by Mr. Wenham was not like mine either in its formula or effects, and that the methods of working and applying the two instruments as accessories to the microscope do not in the least resemble each other." As the principle and use of the appliances are quite identical, the arrogance and utter mendacity of this statement is remarkable, and as might be expected of one who can strut forth in borrowed plumes to grasp an altern fame, he has displayed a corresponding degree of mental incapacity, not even competent to devise the size of a paraboloid that will give the best effect, as revealed by his figure in the last edition of a standard work on the microscope, wherein he has contrived to get his own name solely attached to the immersion paraboloid.

In order to obviate the inconvenience of the right-angled prism and hemispherical lens, which at times require the aid of supplementary condensing lenses, set at the desired angle of obliquity, and to find a form that should be complete in itself, the following appliance was made. *a* is a well-polished cylinder of glass three-eighths of an inch in diameter. One of the flat ends is also polished and attached to the under side of the slide *b* by oil. A ray of light thrown nearly parallel on the outside is refracted within the cylinder at an angle of near 41°, and the nearer the rays approach the line of the object-slide the less the refraction. The light was condensed as a narrow band in the length of the cylinder. The chromatic effects of refraction were inappreciable, and the striæ of amphipleura were resolved by it. The objections were a difficulty of intensifying the light to the centre on to the object, and also that obliquities below 41° could not be obtained. I then substituted a polished glass cone of about 60°, with its base attached to the slide as above. This was found to be a great improvement, but still there remained a difficulty of concentrating the most light towards the object above the centre of the base.

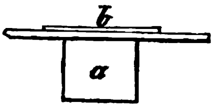


Fig. 2.

A narrow line of light thrown across the object is very efficient for the purpose of developing striæ, and to obtain this line the following form was finally adopted, as shown full size. 1 is a side view and 2 an edge view. It consists of a semicircular disc of glass of one quarter of an inch radius; the edge is rounded and well polished to a transverse radius of one-tenth of an inch, for the reason that the focus of a spherical surface on crown glass falls within its substance to nearly three times the radius, consequently the line of light will be in the most concentrated position at one-twentieth of an inch above the centre of the semi-disc, which distance is sufficient to reach objects mounted on slides of the usual thickness, to the under side of which it is connected with water or more refractive oil. The sides of the semi-

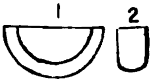


Fig. 3.

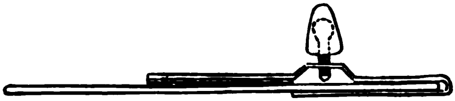
disc are grasped by a simple kind of open clip attached to the substage. This illuminator is complete in itself, and requires no supplementary condensing lens; the obliquity is simply obtained by swinging the ordinary mirror sideways, and by this means amphipleura mounted in balsam can be at once resolved.

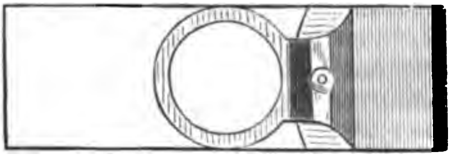
The disc illuminator is very easy to make. The polished edges of two suitable pieces of glass are cemented together with shellac. One face is then ground flat and attached to a brass chuck with sealing wax, seeing that the line of junction falls in the centre, the disc is then turned or ground down to a circle half an inch in diameter. The edge is next rounded and ground true by means o a piece of brass having a channel cut in it of one-tenth radius, then smooth with the finest emery, rocking the brass grinder and reversing it freqnently to equalize the curve. The polisher is a stick of wood with a one-tenth radius notch cut in the end; this is held on the T rest and pressed on the edge of the glass with a rocking motion from side to side, occasionally turning it over, using crocus and water, and as it is important that there should be no rings visible in the polish, the last finish must be given by melting some hard pitch or polishing wax into the groove in the stick, and finish with this and fine rouge. The half-discs, when separated, produce two illuminators of equal form.—*English Mechanic.*

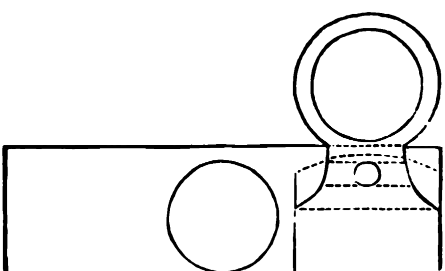
Simple Compressorium.

FOR the ordinary study of pond life, for the examination of pollens, of thin vegetable tissues, the fixing of active subjects for the camera, and for crushing and the avoidance of crushing of delicate objects, I have found nothing more convenient, simple and cheap, than the device of which a description follows. It is a light compressorium made of a single piece of hard brass (No. 26,) folded over the end of a common glass slide, beneath, to the extent of an inch, and closely fitting, above, terminating in a flat ring an inch in diameter, with an aperture of three-quarters of an inch, whose centre rests a little beyond the centre of the slide. The metal is cut away a little, symmetrically, behind the ring, and the central part of this narrowed portion is raised an eighth of an inch from the slide by a series of four obtuse-angle bends, in order to give working room for a screw, which pierces and works in the centre of the raised plane and rests by its tapering smooth point upon the slide itself. The upper surface of the plate is depressed near its duplicature to give a bearing upon the slide somewhat independent of that of the screw, and this gives smoother motion and easier handling. The head of the screw, flattened under a hammer, is covered with a minute cork, head downwards, carefully centered, smoothed and rounded, by which good and steady hold is obtained with a light touch. Upon the under surface of the ring an inch cover-glass, of a thickness adapted to the objectives in use, is cemented by a mixture of equal parts of beeswax and liquid balsam, a material which is sufficiently firm with ordinary care, and which admits of easy change in case of breakage. Upon the upper surface of the slide, concentrically with the aperture in the ring, a thickish cover-glass, three-quarters of an inch in diameter, is permanently cemented with balsam. The object of this is to limit to the field of view (not speaking technically,) the capillary spread of the fluid under observation. It also allows the easier introduction, by needles or filaments of glass, of stainnig and other reagents. When fresh material is to be examined, or the glasses are to be wiped, the instrument is not to be removed from the slide, but simply turned, after screwing up the ring, to a position at the end of the slide, at right angles to the normal one, by which both surfaces requiring attention are exposed. C. W. S.

[The device described above, will be recognised as essentially a modification of the well-known compressor of Mr. Wenham, and the following figures, which accompanied the foregoing description, give a clear idea of its form and construction. Fig 1, is a section of the brass plate, as fitted to the glass slide; Fig. 2 is a plan of the compressorium; and Fig. 3 shows the same with the brass plate turned to one side as explained by the inventor.


COMPRESSORIUM, FIG. 1.


COMPRESSORIUM, FIG. 2


COMPRESSORIUM, FIG. 3.

Instead of attaching the thin glass to a glass slide, however, it is better to make the slide of brass, with a hole through the centre. Nothing then interferes with the passage of the light, and condensers, etc., can be used very conveniently.

We received some time ago, a very excellent compressorium of this form, from Mr. Geo. O. Mitchell, of Dartmouth College, Hanover, N. H. It was nickel plated and very neatly made. We believe Mr. Mitchell has made arrangements to supply these compressoriums to those who wish them.—Ed. Am. Jour. Mic.]

On Tactile Hairs.*

BY LESTER CURTIS, A.B., M.D.

Professor of Histology in the Chicago Medical College.

WHILE making some preparations to illustrate the structure of the skin and hair to my class last winter, I happened upon a peculiar variety of hair in the snout of certain animals, which, at the time, was new to me. Although I have of late been so occupied with other things that I have not had time to complete my investigations, your Secretary has been kind enough to think that what I have seen might not be uninteresting to the Society, and I have therefore concluded to bring before you the result of my observations, notwithstanding their incompleteness.

As the most of you are not physicians, and so, perhaps, have not paid special attention to animal histology, it may not be out of place to call your attention to one or two points in regard to the growth of the hair.

The common hair grows from a conical elevation, situated at the bottom of a tubular depression of the lower layer of the skin. This conical elevation is called a hair papilla; the depression is called a hair follicle; the portion of the hair contained within the follicle is called the root. The lower portion of the root is composed of a mass of rounded cells. Below, these cells are soft and pulpy; further along, towards the mouth of the follicle, they become drier and more elongated, and finally form the shaft of the hair.

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*Read before the State Microscopical Society of Illinois.

The lower end of the hair follicle is surrounded by a network of bloodvessels. Branches from the bloodvessels also pass up into the papilla. The hair grows by the multiplication of the soft cells surrounding the papilla. By the peculiar arrangement of bloodvessels these cells are supplied with nutrition on both sides, from the vessels within the papilla, and also from those surrounding the follicle. The cells continually forming at the bottom of the follicle push the old cells further and further away. The old cells as they recede from their original bed become drier and more spindle

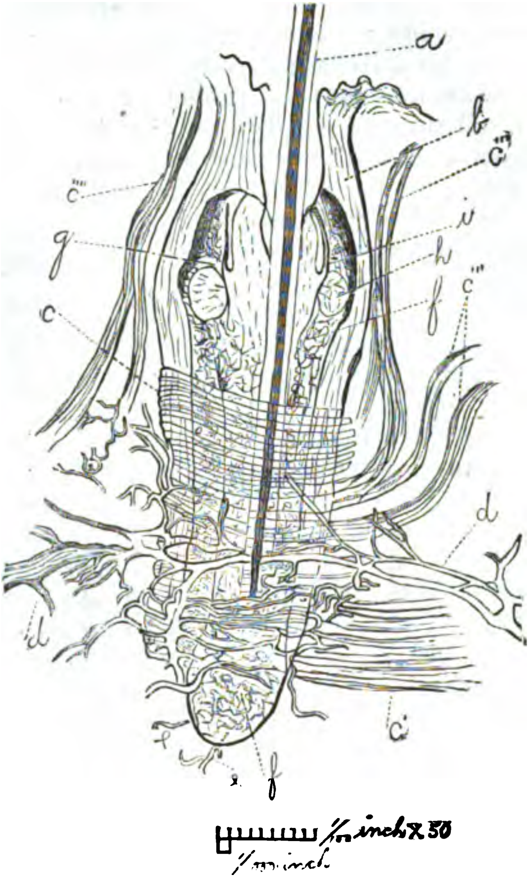

Fig. 1.

shaped, and finally form the shaft of the hair.

Lying between the hair and the follicle is a cellular layer which passes down from the outer layer of the skin and joins the mass of cells at the bottom of the follicle. This inner layer is called the root sheath. The root of the hair, then, has two structures surrounding it derived from the two layers of the skin; the follicle, or follicular sheath, from the lower layer of the skin, and the root sheath from the outer layer of the skin.

In the upper portion of the follicle open the ducts of one or two oil glands for the lubrication of the hair. There may also be sometimes found one or two small bundles of muscular fibres attached to the side of the follicle, the contraction of which would tend to raise the hair, or make it "stand on end."

Many of the hair follicles in some sections of a mouse's snout which I was examining differed markedly from this.

One of the most noticeable things about them was their size. An ordinary hair follicle is but little larger than the hair it surrounds; but in some of these the follicle is so large that the hair, in comparison, looks almost like a broom handle sticking out of a barrel.

These follicles are surrounded by a layer of muscular fibres of the striated variety, such as in the human body are always subject to the control of the will. The fibres are attached to the side of the follicle by a sort of tendon; they wind around it, forming a layer of the depth of one or two fibres, and then pass off to one side to mingle with the other muscular fibres which pass in every direction through the substance of the lip. They are supplied with a great number of capillary bloodvessels of unusually large size.

In many of the follicles, if not in all, one or two bundles of striated muscular fibres start from the above-mentioned muscular ring and pass upwards at an acute angle to become lost in the lower layer of the true skin.

These follicles seem, therefore, to have a muscular apparatus capable of grasping them firmly, and of directing the hairs contained in them accurately in any direction. This muscular apparatus, if we may judge from other like muscles, is under the control of the will.

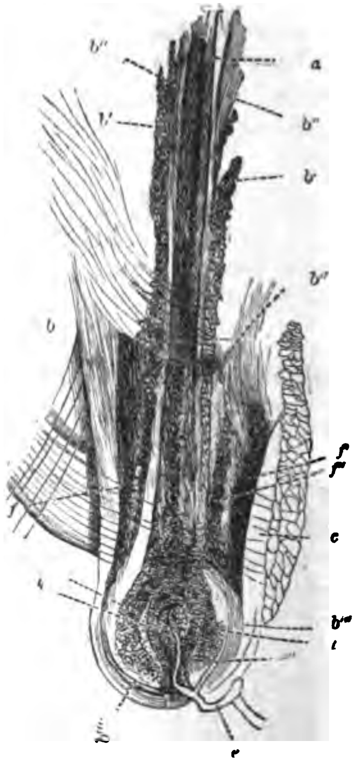

Fig. 2.

Within the muscular sheath, the follicle is peculiar. I have already referred to its unusual size, much greater than is accounted for by the size of the hair it encloses. It has also a singular bulging about one-third of the way from the top. This bulging corresponds to an enlargement on the outside of the root sheath.

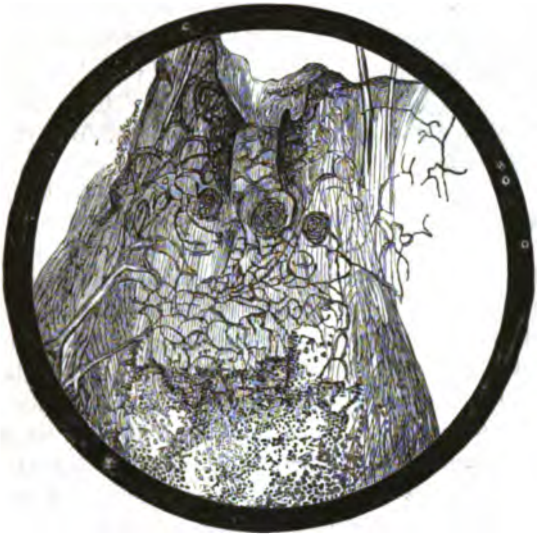

Fig. 3.

Within the follicle, between it and the root sheath, is a close network of fine capillaries, which surround the root sheath and pass upwards and over the enlargement just mentioned. Above the enlargement the small capillaries empty into a plexus of larger vessels. Between this plexus and the enlargement is what at first sight appears to be a large vascular channel with no very well defined walls. Subsequent investigation, however, has convinced me that this apparent channel or sinus is really composed of a collection of vessels lying close together, with but little intervening tissue; reminding one of erectile tissue. From this place the blood passes by trunks of considerable size to the upper part of the follicle, where it empties into a ring-like vessel which surrounds the mouth of the follicle, whence it is conveyed away by veins. A considerable proportion of the blood enters this network at the lower end of the follicle. Some, however, enters through the sides of the follicle.

Within the root sheath the hair grows from a mass of cells surrounding a papilla, which is quite large, but is in all other respects like that of an ordinary hair.

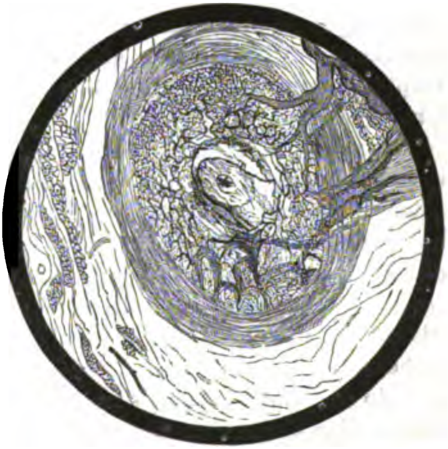

Fig. 4.

The ordinary hair has no such vascular arrangement; its supply of blood is derived from the bloodvessels of the papilla and the plexus outside the follicle.

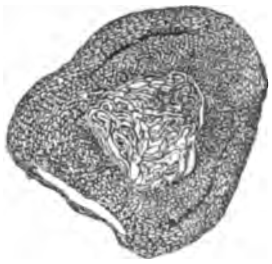

Fig. 5.

The enlargement before mentioned is, however, the most peculiar of all the structures about this singular hair. It is situated within the follicular sheath and outside the root sheath, around which it forms a ring-like swelling. It is divided into two portions. An outer one which, when the hair is split lengthwise, has a nearly circular outline and is attached to the inner by a narrow pedicle. It contains many oval nuclei. The inner portion is narrower from side to side, and longer in the direction of the hair. It surrounds the root sheath like a band. The outer enlargement has resting upon its upper part the erectile arrangement of bloodvessels, and is also completely surrounded by a rich plexus of bloodvessels.

The whole compound enlargement seems to be distinct from the root sheath, although closely connected with it. Penetrating the follicular sheath are seen here and there fibres which form a plexus between the root sheath and the follicular sheath, and appear to terminate in the enlargement. These fibres seem to me to be nerves, although I have not yet traced a connection between them and an undoubted nerve fibre. I consider the enlargement also to be of a nervous nature, and to correspond with the terminal organs found on the extremities of the nerves in so many localities. The investigation of the subject, however, is attended with many difficulties, and I am not at present prepared to give a positive opinion.

Perhaps I should say a word as to the function of these hairs. It is well known that a large number of animals are able to run with full speed through dark passages without coming in contact with any obstacle. Mice and rats will run with the greatest speed and certainty between the partitions of a house where no ray of light ever comes; and cats will chase them with equal certainty through the intricacies of a dark cellar full of lumber. Bats will flit through a dark room and never meet with an accident. Many other nocturnal animals can do the same thing. This seemingly mysterious power may be perfectly explained if these hairs, which all such animals have in great numbers in many parts of their bodies, are furnished at their roots with an acutely sensitive nervous apparatus.

As I said in the beginning, while I was making these observations I was not aware that anything had been written upon the subject, and I still do not know that any thing recent has been printed in English. I find, however, several voluminous papers in German.

Lydig published an article in *Muller's Archiv* in 1859, on "The External Covering of Carnivors," in which he describes several varieties of these hairs.

Odenius has also written an article which appeared in the second volume of *Schultze's Archiv*, translated from some Swedish journal. It was entitled "A Consideration of what is known Concerning the Anatomical Forms of Tactile Hairs."

The most voluminous writer on the subject, as well as the most recent, however, is Dr. Jos. Schobl, of Prague, who has published several articles. His first, entitled "The Wing Membrane of the Bat, Especially the Endings of its Nerves," appeared in vol. 7 of *Max Schultze's Archiv*, in which he gives his idea of the termination of nerves in these hairs. In a later part of this same volume he published a second article on "The External Ear of the Mouse as a Tactile Organ," in which he investigates its tactile hairs. In volume 8 of the same journal he published a third article on "The Tactile Hairs in the External Ear of the Hedge-Hog." In volume 9 of the same journal he published a fourth article, expanding and elaborating more fully his previous ideas.

In all these papers Schobl's drawings differ in many points from my specimens, and I probably should not have ventured to present the subject before you, at least in its present somewhat crude state, were it not that Dr. Beale, of London, an authority whom few of us would feel like disputing, disagrees entirely with the accuracy of his conclusions.

785 Wabash Avenue, Chicago, March, 1879.

Description of the Figures.

FIGURE 1. From mouse's nose. Longitudinal section showing the whole follicle, magnified 50 diameters.

a, Hair.
b, Hair follicle.
c, Muscular ring around the follicle.
c″, Portion of muscular ring passing off horizontally.
c‴, *c⁗*, Branches from the muscular ring passing up to the lower layer of the skin.
d, Blood vessels of muscular ring.
e, Capillaries entering the papilla at the base of the follicle.
f, Capillary network within the follicle between it and the root-sheath.
g, Location of supposed ring sinus.
h, Outer enlargement.

FIGURE 2. From mouse's nose. Showing lower portion of follicle. Section slightly oblique.

a, Hair enclosed within the follicle.
b, Lower portion of the follicle.
b′, *b″*, Two layers of the root-sheath.
b‴, *b⁗*, The follicle surrounding the hair bulb.
c, Section of the muscular ring.
e, Capillary entering the papilla of the hair.
e′, Capillary within the papilla.
e″, Branch passing from capillary of papilla to join capillary network within the follicle.
f, Capillary network within the follicle. The separate vessels can not be seen with this power.
f′, *f″*, Two layers of this plexus; one next the follicle, one next the root-sheath.
k, Papilla of the hair.
l, Layer of cells surrounding the papilla from which the hair grows. *See Note.*

FIGURE 3. Longitudinal section showing the upper portion of the inside of the follicle, extending down past the location of the enlargement; the hair has been removed in making the section. The three round bodies near the top of the figure are sections of the ducts of sebaceous glands. To the left is shown the manner in which the blood passes from the vessels within the follicle into the veins. No indication of a ring sinus can be detected. To the right are seen two ordinary hairs. Specimen was taken from a kitten. *See Note.*

FIGURE 4. Cross section somewhat higher up than the last. The section is slightly oblique. From a kitten.

In the centre is seen the hair enclosing the tip of the papilla with its vessels. The section is made above what appears to be the tip of the papilla, and shows that the papilla extends upwards for some distance as a slender conical point, which is enclosed within the fully formed hair.

At the upper right hand portion of the figure is seen a bloodvessel which penetrates the follicle, and breaks up into a network of capillaries within. Below the vessel is a nerve trunk enclosing two or three small vessels. The nerve also penetrates the follicle and breaks up into a network. *See Note.*

FIGURE 5. Cross section about midway of the papilla. From a kitten. Within is shown the abundant network of vessels supplying the papilla. Next, the papilla is seen, the bulb of the

hair composed of rounded cells, and not yet separated into the different structures which spring from it; without is the follicular sheath which is here composed of cells. *See Note.*

[Note.—Figs. 2, 3, 4, 5 are magnified *about* three times as highly as Fig. 1, but a carefully prepared scale of the amplification which accompanied them has been destroyed by the engraver, and can nut now be reproduced.—L. C.]

A Micrometric Unit.

THE Royal Microscopical Society has taken up this subject and discussed it thoroughly, arriving at the same conclusion as that reached by American microscopists. The resolution adopted by the Society is as follows:

"That in the opinion of this Society, the 1-100 of a millimetre is too large a unit for micrometric measurements, and that it is not expedient at present to prescribe by any formal resolution the adoption of a fixed standard for micrometry."

In the discussions which have taken place both in this country and before the European societies, there seems to be a confusion of ideas, or at least of terms, in regard to this matter, the words "standard," "system," and "unit," being used apparently as if they were interchangeable, which they certainly are not. On the part of the distinguished members of the various societies this no doubt arises from pure inadvertence, but for the benefit of some of our younger readers, a few words of explanation may not be out of place.

When men start out to establish a standard measure, the first thing to be done, is to decide upon the system according to which the standard shall be constructed. In old times the length of the foot of the King, or chief ruler, was adopted as a standard; more recently, in England, the length of "three barley corns, well grown and from the middle of the ear," was the standard from which measures of length were worked out. Such rude systems have, of course, long been abandoned, and at present there are two systems according to which standard measures are constructed and divided. The English system has adopted the length of a pendulum, vibrating seconds in a certain latitude, and under certain conditions, as the theoretical basis of measures of length, though practically the standard is the distance, at the temperature of 62° Fahrenheit, between two marks on a certain bar which is kept in the office of the Exchequer at Westminster. This latter distance is called a *yard*, and is divided into feet, inches and lines. The line is the twelfth part of the inch, but very frequently the inch is divided into eighths or tenths, and even the foot, instead of being divided into inches, is, especially by engineers, divided into tenths.

The method of finding the standard and of dividing it, is called the "system." The one we have just described is known as the English system.

The French, or metric system, determines (theoretically) the length of the standard by declaring it to be the one ten-millionth part of the distance from the equator to the pole. Practically, however, the standard is the distance between the ends of a certain bar, and this bar is divided decimally—that is into tenths, hundredths, thousandths, etc. Here again the method of finding the standard and of dividing it, forms the "system," and the one just described is known as the French or metric system.

The "standards" are the actual bars, and the distances marked on them, which have been declared absolutely to be certain measures. To these standards, and to them alone, all measures must be ultimately referred. The United States standards are copies of the French and English standards. There is a popular error to the effect that the United States foot differs from the English foot, but this is not the case. They are identical.

The idea of introducing another *standard*, as recently proposed, is simply absurd, and has been so pronounced by all who have given the matter careful thought. Nothing could tend so powerfully to create confusion as the introduction of new standards. Moreover, such standards, if they retained the present nomenclature, as is suggested, would carry a lie on their labels—professing to be absolutely accurate parts of a metre when they were not. There is no way to get out of the difficulty attending inaccurate copying of the legal standard, except careful comparison and noting of errors. As this is a difficult and expensive process for individuals, it might be well for some prominent society to undertake the examination and verification of micrometers, just as thermometers and other meteorological instruments are now examined and their errors noted at Kew. But, of course, here again would come up the question, Who shall verify the standard of the Society? The best way out of this difficulty we shall not now consider.

The "unit" is simply that fraction or multiple of the standard which is generally used to express distances. In travelling, the unit is generally a mile; clothiers use the yard, carpenters the foot. At least this is the case where the English system and standard are used. For smaller measurements the inch and its divisions, as tenths, lines, hundredths, thousandths, etc., come into play. Microscopists who use the English system generally adopt the inch as the unit and indicate smaller parts by decimals. Those who use the French or metric system, in which the metre is the unit for large objects, adopt the millimetre or the thousandth of a meter as a unit. In any case, however, the unit is a matter of minor importance. Unless the unit is exceedingly small we cannot hope to escape fractions, and after all there is very little choice between 3785 units and ·3785 parts of a unit, although the one number is ten thousand times less than the other. So far as all processes of comparison and all questions of memory are concerned, they stand on the same level, and, if the introduction of the smaller unit necessitates the use of new metrological nomenclature, it is certainly to be avoided.

By keeping in mind the distinction between "systems," "standards," and "units," our readers will find the subject greatly simplified.

Amateur Lens Grinding.

SOME articles on this subject which appeared in the *Young Scientist* seem to have greatly interested the readers of that journal, so much so, that the editor feels warranted in giving them more. He has therefore decided to republish Mr. Wenham's well-known articles giving full directions for making achromatic objectives of really good working qualities. Who knows but what the impetus thus given to these young amateurs may lead some of them to become a second Spencer or Tolles? As the subscription to the *Young Scientist* is only fifty cents a year, these papers will be placed within the reach of every one that is interested in the subject.

Volume I. Out of Print.

WE regret to be obliged to announce that Volume One of the AMERICAN JOURNAL OF MICROSCOPY is out of print, and can no longer be furnished to clubs.

THE AMERICAN

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AND

POPULAR SCIENCE.

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The Journal as an Advertising Medium.

An advertiser whose letter can be examined at our office writes us as follows: "I have received several letters of inquiry, and it will please you to know that though I have had advertisements in other journals also, *every* letter of inquiry refers to the AMERICAN JOURNAL OF MICROSCOPY. This certainly demonstrates the value of the journal as an advertising medium."

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To Our Subscribers.

EXTENSIVE changes in our business as well as removal to larger and more commodious quarters, temporarily interrupted the issue of the JOURNAL. We have, therefore, concluded to issue the remaining numbers of the year in two parts of which the present is one. The other will be issued very soon.

The JOURNAL for 1880 will be issued regularly during the year and will be greatly improved in many respects. Our arrangements are such that we hope to give our readers a better journal than ever before.

The Aim and Scope of this Journal.

IN another column will be found a letter upon this subject from a gentleman whose name is familiar to the readers of this journal. In that letter he states very forcibly the difficulties which so frequently prevent students from procuring the memoirs and papers which they require, and so far as the difficulties themselves are concerned, the matter could not have been presented more clearly or forcibly. As regards a remedy, however, we fear that the day is not at hand when publishers will be found willing to undertake the issue of papers of which only one or two hundred copies can be sold. The expense of printing one hundred copies of a paper, is very nearly as great as that of two hundred and fifty, and where the illustrations are numerous and elaborate, the cost is almost prohibitory, if only the smaller number can be disposed of. Even where type-setting and press work alone are concerned, the cost of each individual copy of a small edition, is so great, that most persons consider it exorbitant. We have now before us two books, one of which is sold at fifteen cents, and the other at seventy-five, and they both contain about the same amount of reading matter. The cheap book has yielded a large profit; the other has barely paid expenses. Some might say, that if the high priced book had been offered for fifteen cents, the publisher would have sold so many more that he would have made a profit. But this is not so. The market for the fifteen cent book is unlimited, while of those who are interested in the seventy-five cent book, the number is very small. We know a distinguished naturalist, who has had in his portfolio for some years, a work of great value, for which he cannot find a publisher, simply because, the expense of the illustrations is more than would probably be realised from the sale of the book. To meet this very difficulty, was one of the objects of the Smithsonian Institute, and they have done a good work in this direction. But, even with their large income, and extended connections they have covered but a very small portion of the ground. What chance then would there be for a private publisher?

So far as this journal is concerned, we have always aided such enterprises to the utmost extent of our power, by giving as wide notice as possible of the issue or proposed issue of any papers relating to matters which would interest our readers.

The alleged expense of scientific journals, and the reason for that great expense must be obvious to every student. We have long been aware of it; we felt it forcibly, when this journal was first started, and with that in view, we made the price as low as fifty cents per year. At the urgent solicitation of many readers, the price was raised to one dollar, and we have been constantly urged to commit the very blunder against which Mr. Lapham so strongly protests, that is, to raise the price and cover a wider field. This we have steadily refused to do, and we have never regretted it.

The secret of the large circulation of the American Journal of Microscopy lies in the fact that the price was low; that we gave more for the money than any other purely scientific journal ever published in this country, and that enormous editions were distributed, a copy having been sent to every one that could by any possibility be interested in the subject, and we have been assured by those whose knowledge and experience entitle them to confidence, that the American Journal of Microscopy has done more to foster the use of the microscope in this country than any other agent.

A practical remedy for the difficulties so clearly stated by Mr. Lapham, will lie in the multiplication of special journals, which will be published at low prices, and will confine themselves strictly to the subjects to which they profess to be devoted. We want a journal of Botany, a journal of Zoology, of Mineralogy, of Cryptogamic plants, (including the microscopic vegetable organisms found in water,) etc.

These journals should be small, low-priced, carefully edited, and confined wholly to the subjects named. Then, as the microscope is employed in the investigation and study of all these different subjects, a low priced journal devoted to a description of all new improvements in that instrument, and to the best methods of using it, will be acceptable to a large class of readers.

For the future we propose to confine ourselves more strictly then ever to the plan originally laid down. There are, of course, some subjects which are of such general interest to all microscopic observers, that they may fairly be entitled to exception, and there are other papers which force themselves upon us, because while ostensibly devoted to some subject of histology, or natural history, they embody methods of working which are important to all microscopists. Witness for example, the researches of Messrs. Dallinger and Drysdale. We know that their papers have been eagerly studied on account of the methods of working therein described, by persons who took merely a general interest in the main object of research. Other articles give descriptions of objects which are of general interest to young microscopists, and so furnish fields of work for those who have microscopes, but do not know what to do with them, and this class is much larger than many would suppose. The tastes and requirements of all these should be met as far as is consistent with the general object of the journal.

In the hope that our course will find favor with the microscopists of this country, we propose to continue the American Journal of Microscopy with increased energy, and our arrangements are now such, that it will be more complete, and better than ever. We beg our readers to remember, however, that it is not a journal of Histology, of Zoology, of Botany, or even of microscopic organisms, but a Journal of Microscopy,—a subject which in its applications is essential to all these.

Preparation of Microscopic Aquatic Animals.

An anonymous writer in the Berlin 'Zeitschrift für Mikroskopie'* gives an account of a process which he has made use of for preparing slides of Infusoria, Rhizopods, Daphnia, Cyclops, Algæ, &c. The only successful attempt in modern times to supply the want of such a process is that of Duncker, of Bernau,† but this, for trade reasons, is kept secret. The author's process, which he thinks may be identical with Duncker's, is as follows :—

By means of a pipette, some drops of the liquid, containing the organisms to be mounted, are introduced into a lac cell not quite hard, and covered with the covering glass. Then some drops of rectified pyroligneous acid (acetum pyrolignosum rectificatum) are placed at the edge of the covering glass so as to be drawn into the cell. This liquid immediately kills all the organisms without altering their form. It only remains to cement the cover down in the usual way. When the pyroligneous acid has become turbid, it must be filtered before being used.

With this method may be combined the staining of the objects by anilin colors. Dissolve one part (in weight) of a solution of anilin color (the best are anilin blue or diamond fuchsin) in 200 parts of distilled water ; after filtering, add 800 parts of pyroligneous acid. Then with this liquid proceed as with the pure acid. After some hours, the objects take a very uniform color; they are then mounted as above, after adding a little more pure acid. If the color is too dark, it can be made lighter with acid. The author thinks that his process is capable of improvement, although he has already obtained excellent results from it, and he lays stress upon the facility with which it can be used in travelling.—*Jour. Royal Mic. Soc.*

Dry Preparations of Diatoms, &c.

Although there are many processes for making balsam preparations of very thin objects which are required to be placed in the most favorable position for observation, or in a particular order, yet few are able to accomplish this readily in the case of dry preparations except M. Möller, whose process is a secret.

The following is said by M. G. Marmod in the 'Journal de Micrographie'* to be a very simple method. Heat a small quantity of oil of cloves, and expose a slide to the vapor until there is deposited on the slide a series of very small drops. These drops take an hour or two to evaporate completely, and there is therefore plenty of time to arrange the diatoms or other objects, which will remain after the evaporation solidly fixed and without deposit.—*Jour. Royal Mic. Soc.*

Preparation of Red Blood-Corpuscles.

Very excellent permanent preparations of the red blood-corpuscles of Amphibia may be made by Ranvier's method, as follows:—Some blood is allowed to drop from a wound into about two hundred times its volume of a saturated picric acid solution. After a few minutes, the picric acid is carefully poured off, leaving most of the corpuscles at the bottom of the dish ; a solution of picro-carmine is then poured over them, and allowed to stand a day or two. The picrocarmin is then poured off, and the sediment put into acid glycerin (glycerin 100 parts, acetic acid 1 part). The corpuscles so treated will last a long time, and may be mounted in the acid glycerin at any time. The neuclei of the corpuscles are stained bright red, and the body light yellow. Corpuscles of *Menobranchus*, which are about twice as large as those of the frog, prepared in this way nearly a year ago, appear perfect as ever.

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* 'Zeitschrift fur Mikroskopie,' vol. i. (1878) p. 273.

† Journal Royal Microscopical Society, vol. i. p. 221.

* 'Journal de Micrographie,' vol. ii. p. 506.

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Support for the Head in Drawing with the Camera Lucida.

A writer in 'Science-Gossip'* points out the assistance which the draughtsman will receive by keeping the *head* steady as well as the hand, and explains a device he had made use of for this purpose. It consists simply of two upright brass rods with a flat sliding cross-bar (covered with some soft substance) between them, which can be screwed tight at any height, and on which the forehead is placed in the position desired.

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Correspondence.

The Editor of the AMERICAN JOURNAL OF MICROSCOPY does not hold himself responsible for opinions or facts stated by correspondents. In this department we accord the widest liberty consistent with proper courtesy.

Measuring Aperture.—A Word for Mr. John Mayall, Jr., and Prof. R. Hitchcock.

Ed. Am. Jour. Microscopy—When I published the article on "Angular Aperture," or rather "Apertometer" in the *American Quarterly Microscopical Journal*, No. 3, I did not intend to notice any criticism, either adverse or favorable, or get into any discussion with those who either would not, or could not, understand the matter as I did; but I cannot help correcting a misapprehension, and I also take this opportunity to assure Mr. Mayall that I *did seriously attempt* to measure the aperture of the 1-8 Spencer, and that, moreover, Mr. Spencer agreed with me that the aperture *was correctly measured as I stated it.* Alluding to the ink spot which stopped out the light, that appeared when one looked into the objective with front system towards the eye, and which, as base of a triangle whose apex was the focal point, gave but 144° for the angle, though the objective on the sector, in the old way of measuring, still gave light outside this 144°, up to 179°, Mr. Mayall says, he "fails to see the value of the experiment." Well, all I have to say is, that if he had put the objective with the ink dot on it, on to the tube of the microscope, and tried to get an image, or, indeed, any light at all through it (if the ink was opaque enough,) he would have seen the value of the experiment, though he would not have seen anything through the microscope. In fact, the ink dot, small as it was, would absolutely stop all light from entering the objective to form an image; and what is the use, or sense, of talking of an angle for an objective, beyond which it is impossible to see anything with it, when it is used on the tube of the microscope? Mr. Mayall does not seem to comprehend that the objective in question, could be altered from a dry to an immersion, in fact was two objectives, and Prof. Hitchcock, when he says, p. 285, vol. 1, *Am. Quart. Mic. Jour.*, that my demonstration on p. 196, "is liable to mislead," makes the same mistake in asserting that I "show *that an objective of* 144° *in air* can pass 87° in balsam." *I show no such thing.* I do show that an objective of 144° in air, can, by using a drop of water, *be converted into another objective*, no longer 144° in air, but having an impossible air angle. The mistake is obvious in both Mr. Mayall's and Prof. Hitchcock's criticisms. And I quite agree with the former, that the air angle cannot be measured direct, of any objective passing 82° or over, in balsam.

Mr. Mayall says, sensibly enough, that "the true air angle can only be actually measured when the objective is adjusted so as to give true focus *in air*, a focus sensibly free from aberration," and I may add, any objective which *has a true air angle*, can, in accordance with this very definition, have that true angle measured. Mr. Mayall must not mix up matters by supposing an immersion is the *same objective as it was when used dry, barring only the closing of the systems, for it is not*, all refraction at the front surface (with homœgeneous fluid,) being dispensed with, and it now has no air angle by his own definition as above, though an equivalent can be computed if the immersion angle is less than 82°.

H. L. SMITH.

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Verification of Objectives.

Ed. Am. Jour. Microscopy—Do the higher power objectives give us correct views of the objects examined with them? Much has been written and published on both sides of this question. The essential points involved in its discussion are certainly fundamental, and even vital.

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* 'Hardwicke's Science-Gossip,' No. 170 (1879) p. 32.

If, on the one hand, it is impossible for us to know whether the several objects viewed are seen as they really are, or are mere illusive "distortions," it follows that the time spent in these investigations is practically thrown away. It can serve no higher purpose than the gratifying of curiosity; it can promote none of the ends of Science, properly so called. But if, on the other hand, it is possible to know assuredly concerning these things, no effort should be spared to put the attainment of such knowledge within the reach of all.

Is there, then, any available means by which definite and reliable conclusions may be arrived at, touching the solution of the question proposed? I think there is.

In seeking to satisfy my own mind in this matter, I have proceeded as follows: Select for examination a minute object—say the seed of some plant—minute, yet of size sufficient to enable one to make out with the utmost certainty its form, color, proportions, and most of the general details of its structure. No one one will dispute the fact that we have in such case a true idea of the object seen. Very well. Now place this object under a low power and examine it closely. Does there appear any "distortion" of the object? Not in the least. In all particulars, of form, color, and proportions, its appearance is identical with that presented to the naked eye. The only change noted is apparent increase of size. "Only this and nothing more." The report which this 2-inch objective brings tallies perfectly with what we already *know* of the object, and is, therefore, *reliable;* reliable not only in this particular instance, but in *all* instances. It thus becomes *an approved standard of reference.*

Now, employing this same objective, the eye-piece in use remaining all the while the same, select some object more minute than the last, say a grain of the pollen of Oxalis stricta, too small to be seen with the naked eye, yet of sufficient magnitude to be made clearly distinct with this low power. From the results of the previous experiment, we are assured that what we now see is the pollen grain *as it really is.* Study it thoroughly until the mind has fully grasped its details of structure, and then exchange the 2-inch for a 1-inch objective. Is there now any "distortion" of the object? Not in the slightest particular. Apparent increase in size is the only change noted. The 1-inch objective in use is therefore *proved reliable,* and becomes a standard by which to estimate the results of the next experiment. Employing this 1-inch objective, select another object still more minute than the last, and proceed with its examination as before; and continue this process of investigation and verification, until you have brought into the chain of evidence, in their regular order, your 1-2, 1-4, 1-8, 1-16, and still higher powers if you choose; and you will find confirmation succeeding confirmation at every step, throughout the entire series.

Without some such process of verification of his objective, it would indeed be absurd for the microscopist to affirm dogmatically that the delicate markings on A. Pellucida, or the features of any other test, are in fact what they appear to be; yet, such verification of his glasses as I have proposed having been made, he *knows* that they do not play him false; he knows and can affirm with as much assurance as anything can be affirmed, that what he discovers by their aid, exists in fact, as he sees it, and is not some illusive "distortion."

J. T. Brownell.

Lyons, N. Y.

The American Journal of Microscopy.—What it Ought to Be and Do.

Ed. Am. Jour. Microscopy—What I have to say here as to the future of this journal I say truly as an outsider. Not having the least interest in the journal, financially or otherwise, I write merely as a friend to science, convinced that, in biology, a radical reform is extremely necessary, if investigators are to profit as much as may be by the labors of others.

My subject naturally falls into two sections.

(1.) *Objections to the present methods of publication employed by scientific investigators.*

As every one knows, the amount of original investigation that is published in *separate* form, is *extremely* small as compared with that which is bound up with other matter in the shape of periodical literature or society-transactions. If I desire to read ALL the original articles bearing upon a certain subject, such as the Fresh-water Rhizopoda, the number of different journals and transactions of societies that I must have at hand is quite appalling, to say nothing of the large works of such men as Ehrenberg, Perty, and Dujardin. This, however, would be no objection if only each number of a periodical or society-report contained nothing but articles upon one subject. While in Germany last year, I read nearly all of the papers on Fresh-water Rhizopoda in existence. I chose this subject largely on account of the fact that its "literature" is far less voluminous than is that of almost any other biological field.

And yet a list of all the separate papers would be apt to astonish by its length one who has never done this sort of reading. In this list I find only one memoir that is procurable by itself alone. This is the celebrated paper by Herting and Lesser, in the tenth volume of the "Archiv. für Mikroskopische Anatomie" Supplementheft, 1874. Strickly speaking, even this article, though of great length (about 200 large pages) is not in separate form, being bound with an article by Herting on the most interesting of all Rhizopoda, Mikrogromia socialis.

As is common among students, my pocket book has never been constituted with a view to buying a great mass of reading matter that I never expect to use, and consequently my only plan was to make use of a library large enough to insure completeness. This I found in Munich. That is to say, I thought as much; 900,000 volumes being about as many as one can expect even a Royal library to contain. I found, however, that even the best of libraries have their little drawbacks, since they are never really complete, and it often happens that volumes are lent out just when you want them, and for weeks and months at a time. However, if one could *always* be within reach of a large public library, such as are common in Germany, (we have none in this country) one would have slight cause for complaint. But to us this is impossible, and what we are to do as regards the literature of the past is much more than I can tell. We certainly cannot buy it, each man for himself, and it would require more than a few even complete reference libraries to meet the wants of so extensive a territory as we Americans inhabit. The case is simply this: One cannot afford to spend a thousand dollars for the sake of getting property worth to him not more at most, than $100. That this is not overdrawn, I leave without more words to the judgment of any competent reader.

It may be said that a Professor of Zoology or Botany, ought to read about everything contained in the leading biological periodicals. This may be true, but many of the best investigators are not Professors, and in any case we have to do not with men as Professors or farmers, but solely with investigators, *discoverers*.

The objection then to the present system of publication, is, that it compels the investigator to buy, in many cases, property at many time its value on account of the fact that he *must* buy very much that he does not want, in order to get what he *must* have if he is to do good work.

(2.) *The best possible way of publishing memoirs.*

Let some publisher appoint men in each department to examine whatever articles may be offered. These men ought to be of the best, and their names must be known so that they would be compelled for sake of their own reputation to examine with care. The publisher must bind himself to publish all writings (from one page to a thousand) that are approved by examiners, *and in a separate form.* To avoid expense of advertising, let a classified list of articles be issued every month, and sent to subscribers for a small sum per annum.

Such in general is the plan I propose. Its merit consists in disposing of the objection made to the present system. I do not suppose any one would be inclined to underate the importance of the objection, and therefore feel certain that this plan would long ago have gone into operation were it not for the fact that publishers are afraid of a book, small or large, whose circulation is apt to be very small. Of course, this is nearly always the case with scientific memoirs. Their sale is limited to those specialists who are interested in the particular theme, plus the book-makers and libraries. By the system now in use, publishers are able to force sales to some others in addition to the above named. To illustrate: A publisher prints five copies of a certain journal which contains five articles on five different special subjects. Five specialists buy each a copy, for sake of the one particular article in which he is interested. The publisher gets $5; $1 per copy. Had he printed and sold each article separately, one copy of each, he would have had to sell each article at the price of five—$1—in order to get same amount for his labor, since the time consumed in printing five copies is not much greater than for one. To be sure, the amount of paper used is five times as great in the former as in the latter cases, so he could afford on this account to sell each article separate for somewhat less than the price of five in journal form. If now five *additional* specialists, induced by a somewhat low price, buy each one of the five separate articles, the publisher can well afford to sell each article at half the price of the whole five in journal form, (50 cents,) less the difference in amount of paper used; so that we may say that a publisher could afford to sell for about forty cents or less, what in journal form would have to sell for $1. As to whether the "five additional specialists" would in all cases be forthcoming or not, must be decided by experience. I have myself little doubt but that they would speedily make their appearance. If not there would be little gained by the separate form plan. However, the time will surely come, when the present expensive and bungling methods will vex us no more. Government may awake to the fact that its duties are not alone to the living, but to future generations, and that in no way can the future be so well provided for as by fostering now the cause of *discovery*. (This is a very different cause from that of education, though the two are usually confused in discussion. In fact, in Germany, this confusion is carried into government action, the encouragement of research being identified with the proper maintenance of the Universities.) In no possible way could government so effectually aid science at so small an expense as by giving to the publisher who should make the lowest bid, a certain amount for every ten pages of such matter as we have in mind; matter which, in the opinion of competent judges, would have a very small sale. In case of such aid we might buy for ten cents what now costs us $1. Of course I do not expect a speedy and general adoption of the above plan. There is, however, one thing that need not wait for the dull comprehension of publishers or for government aid. We have here a journal that for our purpose can be made to rank high above any other microscopical journal that has ever exised.

If we take the German, English and American periodicals that are devoted more or less definitely to the publication of discoveries made by the microscope, we find in every case a terrible mixture of all sorts of matter. This is especially noticeable in "Silliman's American Journal" and in the "Annals and Magazine of Natural History." But each and every such periodical has completely disregarded the one great principle of true journalism. "*Print only such matter as will be acceptable to the great majority of the readers for whom the journal is intended.*"

The American Journal of Microscopy has alone adhered pretty closely to this principle. With few exceptions, it has of late remained true to its object, which it thus states: "The diffusion of a knowledge of the best methods of using the microscope; of all valuable improvements in the instrument and its accessories, and of all new methods of microscopical investigation." In all these things every investigator who uses a microscope is deeply interested; they constitute the bond by which all microscopists are united into a special brotherhood.

Biology is becoming more and more a microscopical science; hence, this or a similar journal, is wanted by nearly every biologist, and by very many investigators in other fields. On account of the limited nature of its object or aim, it must remain of small size even smaller perhaps than at present, and this, together with the large number of buyers, would keep the subscription price low. Whatever be the fact, this journal ought to have and keep a large circulation on account of its character and cheapness. Now this extent of circulation which is the natural right, so to speak, of this journal, is the thing that is important for our purpose.

This purpose is to have this journal take the place, for American Biology, of the "classified list" above mentioned, its publisher being the one who undertakes to publish all such approved matter as would sell in sufficient quantity, in separate form, i.e., each article by itself.

The journal *is* just about what it ought to be; it remains for it to *do* some things that would be of vast good to itself and science.

Let it undertake to publish as many original scientific memoirs as seem practical. These will find in the journal the most effective mode of advertisement, their names, the character of contents, one or two of the leading points made, and author's name, will find their way in this manner to nearly all the biological investigators in the world.

If the journal be sent for a time free to all the libraries of the world that are of sufficient importance, and to a few of the more prominent biologists of Europe, until it becomes everywhere well known that through it alone can one know what is being done by American investigators, (it is little enough to be sure), and from it alone can the results of each investigation be obtained without paying for undesired matter; it cannot fail to happen that the journal will secure a greatly increased circulation; authors a greater number of readers, and readers a very great deal of matter that, with the present system, they cannot afford to buy.

In case some such plan as the above should ever go into operation, it is clear that every investigator who works with any other motive than gain, would publish in this manner, since the interests of science are thus best secured.

If the editor will kindly append a short criticism of the above, with an estimate of the price at which an article of given length with a few wood-cuts could be sold to 200 buyers, he will greatly oblige,

W. G. Lapham.

Northville, Mich., Dec. 1, 1879.

Corethra Plumicornis.

Ed. Am. Jour. Microscopy—In looking over your March number of the JOURNAL, I see a notice of the *Corethra Plumicornis* as found about Buffalo. I wish merely to state that I have found them in great numbers in my vicinity for several years, and have shown them to large audiences, by the Hydro-Oxygen Microscope. The whole internal motion of respiration is most beautifully developed. I find them in several ponds near my residence. A. A. STARR.

Westfield, N. J.

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A Correction.

Ed. Am. Jour. Microscopy—In the report of the annual meeting of the San Francisco Microscopical Society, held January 13th, contained in your March number, p. 71, it is stated that I presented the Society with seven slides of diatoms, finely cleaned and mounted by myself, from Santa Monica, Richmond, Maryland, Meads' Pond, and Lily Pond, (Waltham, Massachusets,) Isles of Shoals, and Patuxent River, N. J.

The last *four* of the above were cleaned by Dr. R. S. Warren of Waltham, Mass., I merely mounted them. In justice to Dr. Warren, I should be much obliged if you would make the correction in your next issue. WM. ASHBURNER.

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Encouragement of Science in Europe.

Ed. Am. Jour. Microscopy—Having read regularly for some years, the "Bulletin de la Société Belge de Microscopie," and having last Fall, at Brussels, through the courtesies of the Secretary, Mr. J. F. Cornet, enjoyed facilities for learning the working of the Society, I have formed a high estimation of its character. The frequent and regular meetings, the length of the seances, and the quality of the work done, are making an impression on Microscopical Science in Europe.

In the just received "Procés-Verbaux Seance du 29 mai 1879," I notice something worthy of imitation at home. Under the head of correspondence read to the Society, is a letter from the Minister of the Interior, announcing the grant of 500 francs to aid in the publication of Vol. IV., of the Annals of the Society. Also, a special subsidy of 1000 francs is put at the disposition of the Society for the completing of its own collection of instruments.

SAMUEL LOCKWOOD,
Sec. N. J. M. Society.

Our Book Table.

How to Work with the Microscope. By Lionel S. Beale, F.R.S., President of the Royal Microscopical Society. Fifth Edition. Revised throughout and much enlarged, with one hundred plates, comprising more than six hundred engravings, some printed in colors, and most of which have been drawn on wood by the Author. London: Harrison.

Dr. Beale's work on the microscope has long been a standard, and it will continue to be such by virtue of the fact that much of it has been written in the laboratory, and conveys information which will enable the student to overcome those difficulties which are constantly met, and which none but workers know or can appreciate. In this respect it stands in marked contrast to many popular books now on the lists. These books have been written by *closet* students, not by laboratory workers, and when the young microscopist attempts to lean on them he finds that they are but broken reeds. In all that pertains to the subject matter indicated by its title, "How to Work with the Microscope," this book is *facile princeps*, and no analysis or criticism of ours is needed to establish the fact. There are, however, some blemishes which we feel ought not to have been allowed to creep into an edition which, after several years, has been "revised throughout." And we cannot help thinking that in some respects Dr. Beale has erred in judgment by admitting to his pages subjects which certainly have nothing to do with a treatise on the *use* of the microscope.

As regards matters which might easily have been corrected, we find the following:

Under the head of test-objects (page 43) we are told that, "according to Prof. Bailey, of the United States *Grammatophora subtilissima* and *Hyalodiscus subtilis* are the most delicate tests." Any reader of this passage would naturally suppose that Prof. Bailey had given this opinion quite recently, whereas Prof. Bailey has been dead many years, and this statement of his is a quarter of a century old. We are told nothing about the more modern tests (diatomaceæous), and Moller's Probe-Platte is not so much as mentioned. Such being the fact the following passage does not excite surprise. Speaking of Nobert's lines, Dr. Beale says: "As test-objects they are equal to and even rival, many natural objects which have hitherto been employed for this purpose. The delicate lines on some of the diatomaceæ are separated from one another by the 1-50,000th of an inch, while the finest lines engraved by M. Nobert are less than the 1-100,000th of an inch apart." How about *Amphipleura pellucida*, as described in another paper in this number?

We may also mention incidentally that Dr. Beale still adheres to the views laid down by him in his earlier edition, and tells us: "It should be borne in mind that the object-glasses, with a very high angle, although very valuable for researches upon the diatomaceæ and other delicate objects of extreme tenuity, do not answer so well for investigations upon the structure of animal and vegetable tissues as glasses of a moderate or low angle." Of course upon this point there is a wide diversity of opinion, but in this country it is generally conceded that object-glasses of high angular aperture are best for most purposes. The only reason why they are not always employed is their high price, and the fact that it requires more skill to use them than is needed for non-adjusting glasses of low or moderate angle.

It seems singular to us that a man who is quoted as high authority in the Journal of the Society of which Dr. Beale is President, should have his name and address mixed up as follows: "Prof. H. Lawrence Smith, of Kenyon College, Gambia, (!) Ohio, U. S." Long before the *fourth* edition of this book was issued Prof. Smith had removed from Kenyon College and accepted a professorship in Hobart College, at Geneva, N.Y. Dr. Beale has evidently confounded the names of two different men—Prof. Hamilton L. Smith, of Geneva, N. Y., well known as an acknowledged authority on the microscope, and especially as one of the foremost authorities in the world on the Diatomaceæ, and Prof. J. Lawrence Smith, the inventor of the inverted microscope, and well known, both in this country and Europe, as a chemist and mineralogist.

Mr. Tolles, also, comes in for his share of blunders. His address is still given as Canastota, N. Y., while the numerous letters which he has written to English microscopical periodicals, dated from Boston, Mass., U. S., ought to have informed Dr. Beale of his whereabouts.

Speaking of object-glasses, Dr. Beale says: "The object-glasses used in the best instruments are of English manufacture, but many really good object-glasses are now furnished with the cheap microscopes, some of which are made on the Continent, and are produced at a very cheap rate." This sounds as if it had been written many years ago.

In the list of foreign makers, at the end of the book, no mention is made of any American optician. Spencer, Tolles, Geo. Wale, and William Wales are alike ignored. And while, in the index, the names of the authors of the most trifling inventions occur with great fulness, *provided they are English*, foreign names of far higher importance are left out. The name of Zeiss does not occur, and although Powell and Leland are credited in the index with their modification of Prof. H. L. Smith's illuminator for opaque objects, no mention of this invention occurs under his name—he being being called merely "Prof. Smith," and credited with a mechanical finger.

We have already said that in our opinion Dr. Beale has erred in admitting to his pages many things which might properly have been omitted from a work on "How to *Work with* the Microscope." If the reader will turn to page 62 he will find a recipe "for cementing stone and for filling crevices in buildings before they are painted." Also a cement for mending stoves. On page 63 is a recipe for *furniture polish*, and immediately following are several recipes which we recognize as those generally employed by machinists, boiler makers, etc. We certainly never knew them to be used in microscopical work, properly so called, and if Dr. Beale justifies their introduction on the ground that the microscopist may require them for repairing his dwelling, or driving the machinery by which his brass work is turned or his lenses ground, then for the same reason he ought to have made his book an Encyclopædia of Technology, and expanded it to thirty or forty quarto volumes.

And this leads us to ask what possible use ordinary workers with the microscope can make of a chapter on glass grinding. Making microscopes is one thing, using them is another. No earnest worker with the microscope has time to spend in making inferior object-glasses when he can buy French triplets for three or four dollars that will probably beat anything he can turn out. As an interesting experiment for amateurs, glass grinding is very well, and in the pages of a book on mechanical manipulation directions for such work find a proper place. But in a treatise on the use of the microscope, we hold that it is entirely out of place, and therefore adds unnecessarily to the expense of the book, and tends to confuse and bewilder the inexperienced student of microscopy. Upon this point we feel that we cannot do better than quote from Dr. Beale himself, who says, in the opening paragraph of his book: "It is not desirable in a practical work like the present to enter into minute details concerning either the mechanical or optical arrangements of the microscope."

The Workshop Companion: A Collection of Useful and Reliable Recipes, Rules, Processes, Methods, Wrinkles and Practical Hints for the Household and the Shop. Price, 35 cents. New York: The Industrial Publication Company.

There is, probably, not a single reader of this notice that has not at some time or other felt the want of some item of information contained in this book, and would gladly have given the price of the volume for one of the recipes. The book covers a very wide range of subjects, there being no less than ninety main articles, some of which contain as many as sixty sub-headings. The pages are of good size and closely printed in very clear type, so that 164 of them contain an unusual amount of matter. The subjects are arranged alphabetically, the work thus forming an almost complete encyclopædia of practical, everyday information.

The thoroughness with which the book has been prepared is best seen by examining a few special subjects. Turning to the article on *Cements*, we find not only a short treatise on the use of cements, but a series of nearly sixty recipes, covering every possible requirement, from aquaria to steam boilers.

Again, under the head of *Inks*, we find not only a series of recipes for almost every variety of ink, but a carefully written article on the selection and use of ink, giving information which is of service to every one, and which but few people possess. The same might be said of *Alloys Lacquers, Steel, Brass, Wood Finishing, Polishing Powders*, etc., to the extent of nearly one hundred distinct subjects. In every case, so far as we can judge, the information given is reliable, and its general usefulness is shown by the fact that in almost all cases it covers the popular uses of the articles as well as their strictly technical relations. Thus, under the head of *Marble*, we find not only directions for working and polishing it, but for preserving and cleaning it, and also hints as regards the ways by which marble articles may be injured.

The publishers undoubtedly anticipate for this book a very large sale, or they could not have made the price so low in proportion to the amount of matter given.

Students' Manual of Urinary Analysis, Chemical and Microscopical. Compiled, Translated, and Abridged from the most recent French Authorities. By Clifford Mitchell, A. B., M. D., Demonstrator of Chemisty, Chicago Homœopathic College. Chicago: Jansen, McClurg & Co.

This is a handy little pocket manual which will serve an admirable purpose as an *aide memoire* to the busy practitioner. To those who have not made a previous study of the subject, and acquired some familiarity with it, this little volume will not take the place of more complete treatises, but to those who require a systematic method in condensed form it will prove very valuable.

A careful examination leads us to regard it as very free from errors of importance, though we notice one or two blemishes, such as the introduction of the French word *Champignons* for *fungi*, and the application of the term "Brownian" to the motion of vibrios, which it certainly may not be unless they are dead.

Current Notes.

Polariscope Objects.—Rev. J. D. King, of Edgartown, Mass. (who, by the way, understands his business in putting up marine objects), observes that Polyzoa always polarize, and the Hydrozoa seldom or never.

A New Coloring Agent.—Tafani, an Italian, mixes a saturated solution of aniline blue with another of picric acid, in the proportion of four parts of the former to one hundred parts of the latter. With this he obtains a beautiful green staining for microscopic specimens.

Microscopical Laboratory.—We are glad to learn that Dr. Carl Seiler, of Philadelphia, has opened in that city a laboratory for microscopical work, where gentlemen, already acquainted with microscopical technology, can work up special subjects, under the guidance of a skilled microscopist. He has also prepared to receive students, who will be instructed in histology, pathology, and microscopical technology, separately and in classes. Dr. Seiler's address is 1608 Pine Street, Philadelphia.

Malassez' Solution.—This solution is of the same specific gravity as fresh blood, and is intended to be mixed with the latter in any definite proportions, in order to be able to count the blood-corpuscles contained in it. It is composed of mucilage of gum-arabic (1 in 2 by weight), 3·75 parts; sodium sulphate, 1·875 parts; sodium chloride, 1·03 parts; distilled water, enough to make 100· parts.

This liquid should be freshly made when wanted as it does not keep long, and should be filtered before use.—*Dr. Vulpius in Pharm. Zeitschr.*

Trichinosis.—In the older States to find trichina in pork is no uncommon thing, but in Oregon such meat was unknown until recently. Willie Palmer, living near Monmouth, died some time since, and Dr. Shipley has discovered that his death was caused by eating trichinous pork. A piece of muscle taken from the body of the dead boy was sent to this city, and under a microscope shows the parasites in great numbers. This is said to be the first case of the disease on the Pacific Coast.

Cleve's Series of Diatoms.—Prof. P. T. Cleve, of Upsala, Sweden, will issue, early in the fall, two parts of his series of diatoms, Nos. IV. and V., which will contain 108 slides.

The diatomaceous material collected by Prof. Nordenskiold in the Arctic regions, has been carefully examined by Profs. Grunow and Cleve, who have now in press a paper containing descriptions of the forms found, illustrated with 4 plates, including 150 figures. This paper will be of considerable value to those studying the Diatomaceæ, owing to the labor bestowed upon it by Prof. Grunow, and will contain complete monographical synopses of the genera of *Achnanthes, Amphiprora, Nitzschia, Pleurosigma*, etc. A few copies will be for sale, and may be ordered from Prof. Cleve.

The Sizes of Ferments.—The *Brewer's Guardian* has compiled from trustworthy authorities the following table, showing the sizes of the various ferments found in beer and other fermented liquors:

	Diameter of the cells in Fraction of an iuch.		
Saccharomyces cerevisiæ	·00031	to	·00035
" minor,	·000315		
" ellipsoideus	·00024	by	·000176
" pastorianus	·0007	by	·00035
" exiguus	·00098	by	·000118
" apiculatus	·000236	by	·000118
" mycoderma	·000118	to	·000787
Viscous ferment	·000047	to	·000055
Lactic "	·0000984		
Butyric "	·0000687	by	·000687
Mycoderma aceti	·000059	by	·000118

Trichinosis in the Hippopotamus.—M. S. Heckel recently submitted a note to the French Academy of Sciences on the discovery of *Trichina spiralis* in a hippopotamus. The animal, about two years of age, had been presented to the Zoological Gardens of the city of Marseilles by the Khedive. At the time of its reception in the gardens it was suffering from boils, which presently ulcerated, and in the end killed the animal. During the four months that this hippopotamus had been confined in Marseilles it had been fed on milk in which flour was mingled and fresh vegetables; but nothing is known of the treatment of the animal before it left Egypt. In the course of stripping the flesh off the carcass in order to preserve the skeleton for the Museum of Natural History at Marseilles, M. Heckel accidentally discovered that the muscles of the animal were infested with the cysts of the *Trichina spiralis*. This discovery took place at too late a period of the process of stripping to enable M. Heckel to make an exhaustive examination of the extent of dissemination of the parasite in the body.

A Poultice of Diatoms.—S. P. Sharples, of Boston, writes as follows to *New Remedies:* A few days ago I received a sample of water for analysis. The water was reported as being very useful in skin diseases. It had a slight smell of some organic compound in a state of decomposition, but on analysis proved to be remarkably pure; the total residue being only 2·03 grains in a U. S. Gallon, and of this ·87 grains were organic. A few days after, the owner of the spring brought me a bottle filled with a light-brownish substance which he said was floating in the spring in such quantities that it had to be pushed to one side to get at the water. He said that the people about the spring used this scum as a poultice, and that it was very efficient.

On examination, this substance was found to be a mass of living diatoms, consisting mainly of *Cocconema cistata*, with a few frustules of several other genera. I suppose the chief virtue of the application must be in the smell thereof, for, after keeping a few hours in a warm place, they do stink most fearfully.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

The American Microscopical Society.—At the annual meeting of the American Microscopical Society of the City of New York, held at its rooms, No. 12 East 22d Street, Tuesday evening, March 25, 1879, the following officers were elected for the ensuing year: President, John B. Rich, M. D., 12 East 22d Street, N. Y.; Vice-President, Wm. H. Atkinson, M. D., 41 East 9th Street, N. Y.; Secretary, O. G. Mason, Bellevue Hospital, N. Y.; Treasurer, T. d'Oremieulx, 7 Winthrop Place, N. Y.; Curator, John Frey, Bellevue Hospital, N. Y. The time of the meetings has been changed from the second and fourth Tuesday to the second and fourth Wednesday of the month.

O. G. MASON, Secretary.

State Microscopical Society of Illinois.—A special meeting of the State Microscopical Society was held at the Academy of Sciences, June 6, 1879, Vice-President Baboock in the chair.

Mr. R. B. Tolles, of Boston, was present and kindly consented to make some exhibitions before the Society. He showed three forms of his new travers lens. The apparatus consists of a convex cylindrical or spherical lens which comes into immersion contact with the slide, glycerine being interposed. The radius of curvature of the lens is equal to the thickness of the lens plus the thickness of the slide, so that the object is at the centre of the curvature of the lens. Beneath the lens there swings on the graduated arc of a circle whose centre is coincident with that of the lens, a condenser which in this case is a low-angled inch objective. The apparatus could be attached to the sub-stage of an ordinary microscope. It was designed to secure the advantages of a sub-stage swinging around the object as a centre, and also to allow the light to pass directly to the object without any change in its direction by refraction occurring at the under surface of the glass slide on which the object rests, or suffering any loss by refraction. With this piece of apparatus on one of Beck's large stands, he showed the lines on the three highest diatoms of Möller's probe platte, that is, the eighteenth, nineteenth and twentieth, using a 1-10 objective of his own make, owned by Mr. Colgrove of this city, both water and glycerine being used as immersion fluids. The resolution was exceedingly fine, nothwithstanding the fact that the thickness of the stage prevented the use of the full aperture of the objective. The amplification was carried up to about four thousand diameters with the 1-4 inch solid eye-piece without seriously impairing the clearness of the definition.

After the members had witnessed the exhibition, Mr. Tolles, by request, made some remarks on the construction of these new objectives. The peculiarity of the lens consisted in the use of two lenses instead of one as a front, or rather of a fourth lens placed in front of an ordinary dry objective.

Prof. Abbe had made the statement that this form of lens was first used in Prussia, but this was a mistake. At least there was no public knowledge of any such lenses in this country or in Europe, and the writings of Mr. Brakey in the *Monthly Microscopical Journal* of London, would indicate that no such plan had been made known in any way either here or in England, until some time after its production here, and its publication with diagrams in the London *Monthly Microscopical Journal*. The idea was not borrowed in any sense, but was original with Tolles so far as he was concerned, and grew out of the absurd discussion on the possibility of an angular aperture greater than eighty-two degrees in immersion objectives for objects mounted in balsam. The first one of these lenses was made to prove the possibility of such a greater angle.

By the use of two lenses a much higher angle can be obtained than is possible with the ordinary form with an equally good result. This hastily constructed lens was casually called a duplex to indicate the double character of the front. The name had been siezed upon and used at home and abroad. The form also had been copied, certainly in this country, and probably in Europe.

The angle in balsam, or, as Dr. Woodward has better called it, in *glass*, in excess of eighty-two degrees is called the outside angle.[*] The value of high angles had given rise to much discussion. It was, however, beyond question that some angle was necessary; an object-glass for the microscope of only two or three degrees of angular aperture would be of small value. If the angular aperture of the lens with which structures were seen so clearly to-night were cut down to the glass angle of eighty-two degrees or less, the other conditions remaining the same, they would be nearly invisible if not quite so. The same result would follow if the obliquity of the illuminating pencil were reduced to forty-one degrees from the optic axis of the objective as can readily be shown with the traverse lens. But this angle of eighty-two degrees in balsam corresponds to an angle of one hundred and eighty degrees in air. All this clearness of vision, therefore, is a gain over the highest possible air limit. Glasses had been made with an angle infinitely near to one hundred and eighty degrees in air, and he thought it possible to construct glasses with a fair approach to as high an angle in balsam as had been done in case of mounts in air. He, himself, had made a glass of one hundred and twenty-three degrees glass angle.[†] In his opinion every step nearer that limit will be so much clear gain to microscopists. After some discussion, and some questions asked, the Society passed a vote of thanks to Mr. Tolles for his exhibition and explanation.

The meeting then adjourned.

E. B. STUART, Secretary.

New Jersey Microscopical Society.—This Society held its ninth anniversary in the lecture room of the Geological Hall of Rutger's College, New Brunswick, N. J., on May 26, at 7 P.M. After a session of a few minutes in a private room for routine business, excepting the President and the appointed speakers who occupied seats on the dais, the Society rejoined their friends in the general audience. An address was made by Dr. H. R. Baldwin, on the Microscope in the Science of Medicine. It was a clear and interesting exhibit of microscopic physiology, intended for a general audience. The Secretary next read a paper entitled, Microscopy versus Superstition. He seemed to have been led to his singular theme by his having, the previous season, discovered among the ruins of an Abbey, at York, England, a large clot of the terrestrial Alga, *Palmella cruentis*, formerly known as Gory Dew. He instanced the fact that the piety of mediæval times had been on occasions severely shocked at finding the interior of churches, and even the Host itself, defiled with fresh blood. On one occasion this horrible miracle was attributed to the Jews, who had suborned the Devil to the horrid act, and a large number of these innocent people were burned at the stake. Although with milder results, these blood portents disturbed the people of Europe down to nearly the middle of the present century, when Ehrenberg took up the matter, working upon some of this mysterious substance taken from a fresh portent. Under his microseope the "blood" was resolved into a unicellular plant, which he proved to be a terrestrial alga, and which received the name *Palmella cruentis*. The paper also took up the old notions of spontaneous generation, and the supernatural origin of disease, which, he contended, so far as complete work had been done by the instrument, were dissipated as illusions.

Exhibitions of slides to the audience was next in order. The Secretary displayed some exquisite double-stainings, showing crystals, in a series of water-plants; these were prepared by W. H. Walmsley. Mr. Noe showed a very fine slide of the organs in the rhubarb, also double-stained. A superior preparation in microlithology by Alexis Julien, a section of granite, was exhibited by Prof. Van Dyck under the polariscope. Dr. Baldwin showed specimens illustrating his address. Perhaps the novelty of the occasion was a slide shown by Dr. Williamson, illustrating the disease known in Great Britain as "miner's phthysis." This was a section of lung of a collier who had died of this malady. Almost the entire tissue of the lung was choked up with particles of coal.

Although nothing very new was presented, yet the occasion was an enjoyable one to a large and an intellectual audience.

SAMUEL LOCKWOOD, Secretary.

American Postal Microscopical Club.—Returns from members indicate the election of the following officers: President, Rev. Samuel Lockwood, Freehold, N. J.; Secretary, Rev. A. B. Hervey, Taunton, Mass.; Ass't Secretary and Treasurer, Joseph McKay, Troy, N. Y.; Managers, R. H. Ward, M. D., Troy, N. Y.; C. M. Vorce, Cleveland, O.

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[*] Since it is *outside* the aperture of any lens when used on objects mounted in fluid, and takes up rays outside the limital point of 41° from the optic axis of the objective when the object is mounted in balsam. In this case we have the limit of the angle of aperture at its minimum 41°, since the refraction of balsam is nearly the same as that of the glass slide. Preservation media of lower refraction index, as glycerine, etc., down to air, give increasingly greater angular aperture for dry objectives while the dry mount (air) affords the maximum angle. The "balsam" or "glass" angle is in all cases readily measured by means of the traverse lens, and the other cases are easily calculated; the corresponding air angle being computed within the arc of 82°.

[†] Made for the Army Medical Museum, and measured by Dr. Woodward.

Those who have not renewed their membership, will confer favor upon the officers and club, by reporting *at once* whether they desire to do so. The whole club is now awaiting these answers. It is not safe to start boxes upon a circuit while the present address, or intended co-operation of a single member remains doubtful. Nor can names which fail to report now, be restored afterward; since the reorganization of the circuits involves serious disadvantage to members (by either duplicating or forfeiting their view of slides which have passed partly around,) and great labor at the headquarters of the club, which when once completed it will be absolutely impracticable to repeat.

Applications for new membership can be entertained to the extent of filling vacancies; but it is deemed injudicious to increase the size of the Club, by adding new circuits. Exceptions to this rule can be made where whole circuits are formed in a single society or town, and managed by a local secretary, a plan which has been so successful that the officers desire to make it more general.

Communications in regrrd to the general management and interests of the Club should be addressed to the Managers, at Troy, N. Y.; but those pertaining to the movement of the boxes, payment of dues, etc., should be directed to the Ass't Secretary, Joseph McKay, 24 Liberty St., Troy, N. Y.

R. H. Ward, C. M. Vorce, Managers.

Microscopical Society of Liverpool.—The eighth ordinary meeting of the eleventh session of this Society was held at the Royal Institution, on Friday evening, October 7th, the President, Rev. W. H. Dallinger, R. M. S., in the chair.

The Hon. Secretary, Mr. I. C. Thompson, announced the following donations, viz: Beale's "How to Work with the Microscope," from the President; Pasteur's "Studies in Fermentation," from W. Edmunds, the Limes, Birkdale; and three slides of mineral crystals, from W. H. Grattand, Honorary Member.

Mr. Charles Botterill exhibited and explained a new form of life slide devised by him, adapted for the examination of a wide range of objects. The advantages claimed for this slide, are the facility with which it can be used and cleaned, its reversibility, allowing either side of the object to be examined through thin glass, the provision for renewing the supply of water without disturbing any part of the apparatus, thus enabling objects to be kept under examination for an indefinite period, the same arrangement also allowing of the introduction of coloring matters, as carmine, indigo, etc., and lastly, its moderate cost and durability.

The President, Rev. W. H. Dallinger, made some valuable remarks entitled "Notes on Bathybius as an Entity at the base of the Organic Series," holding that Bathybius, as admitted by Huxley himself, has a very doubtful existence, and that it is not wise to bolster up an hypothesis quite capable of standing without Bathybius as an argument in its favor, seeing that the Foraminifera furnish an example of the simplist form of granuleless Protoplasm, and, therefore, stand much lower in the scale of animal life than even the Amœbæ.

The Rev. H. H. Higgins made some interesting observations on the "Plasmodium of the Myxomycetes," illustrated by diagrams. He described some researches which he and Rev. Wm. Banister had made upon this fungoid condition, and from which he had, after considerable patient watching, succeeded in detaching a small speck which exhibited under the microscope, the true amœboid form showing curiously-shaped moving pseudopodia. The Rev. Wm. Banister followed with further observations on the subject. The meeting concluded with the usual conversazione.

The Wellesley College Microscopical Society.—This Society gave a reception in the Museum of the College on the evening of June 16. Dr. Hunt, President of the Boston Microscopical Society, was present, and many of the members; also other distinguished friends of science and education.

The exhibits, under 50 microscopes, were mostly specimens of the work of members of the Society, and some of the more interesting were as follows:

Anatomy of a Cricket, under nine microscopes, accompanied by illustrative drawings, showing tracheæ, labrum, maxillæ and mandibles, digestive tract, inside of proventriculus, cornea, vertical section of eye, nervous system. Skin—papillæ with taste-bulbs, touch corpuscles of skin. Skin of Frog under 1-25. Hair-follicle with oil gland and sweat gland. Section of retina showing seven layers. There were several very interesting preparations from the Cray fish. The liver cæcum; section of liver injected, etc. On another table were exhibited bread and cheese mould, and the mycelium of bread mould; also sporangia. Fibro-vascular bundles in corn stalk, also annular and reticulated vessels, and stellate tissue in transverse section of nuphar advena.

On another table were pollens of various plants, and plant hairs, peristome and operculum of moss, cells of petal of pelargonium, fresh water algæ, circulation in stamen of tradescantia.

Blood corpuscles of newt, and circulation in arteries and capillaries of mesentery of frog, and several living specimens of hydroids and bryozoa occupied another table. The Sorby-Browning micro-spectroscope with bright line micrometer, showing absorption bands in blood, attracted much attention. Two microscopes were devoted to rock sections. Miscellaneous specimens mounted by members of the Society were exhibited under two binoculars and Zentmeyer's American Centennial, with paraboloid. There were also shown micro-photographs, multiple images in eye of beetle, starch grains of tous-les-mois, and quinate of quinine with polariscope.

A table was devoted to mounting materials, and the processes illustrated by the ladies in attendance; and another table which attracted much interest was filled with specimens of the elegant illustrated volumes from the microscopical library, and the journals of reference, American and foreign.

Many of the slides were demonstrated by the assistance of drawings and charts. Adjourned until September.

MARION METCALF, Corresponding Sec'y.

Philadelphia Academy of Natural Sciences—Microscopical and Biological Section.—A regular meeting was held Oct. 4, 1879, Dr. Kenderdine, President, in the chair. After the usual routine business, Dr. Carl Seiler, the lecturer for the evening, spoke at length upon the subject of the "Histology of Tumors." He said that he did not wish to enter too fully or too scientifically into the histology of tumors, as there is so much difference of opinion among students in regard to the morbid processes involved, and because he desired to adapt his remarks to the comprehension of all the audience.

All tumors were formerly divided into sarcomata and carcinomata. They are still so named, but the sarcomata, or *fleshy tumors*, were considered harmless, while the carcinomata, or cancerous, were held to be malignant. The lecturer then said that there were many of the sarcomata as malignant as the carcinomata, the malignancy depending in great measure upon the position of the tumor and the proneness to secondary deposits of tumors in distant organs. To illustrate this point, he called attention to the fact lately brought forward by Dr. S. W. Gross, of Philadelphia, that the round and spindle-celled sarcoma of the long bones are by far the most malignant tumors, and that they usually formed secondary deposits in the lungs, to which the patient succumbs. The same form of tumor in connection with other bones was not to be considered very malignant, and could be removed by an operation with considerable hope of saving life.

Tumors are at the present day divided into: first, those formed of *connective-tissue* elements in various stages of development; and second, those formed of *epithelial* structures. The presence of the so-called *cancer-cell* or *spindle-cell* was formerly regarded as the certain evidence of a malignant growth, and until a period within the last ten years was so taught in our medical schools. This spindle-cell is also found in normal connective tissues, in embryonic tissues, cicatrices, etc.; and although such distinguished histologists as Virchow, Billroth, and Rokitansky have endeavored to find a special cell indicative of the malignant nature of cancer, they have never succeeded. All are agreed that cancer should not be regarded as anything distinct, and that its cell-elements are either identical with the embryonic or with the fully developed tissues. The simplest form of tumor is found in *granulating tissue*, or what is known as *proud flesh*. When we make a section of such a neoplasm we find that the cells present the simple round appearance analogous to the embryonic connective-tissue cell, and precisely identical with the cells of the round-celled sarcoma. A similarity also exists in the blood-channels of the round-celled sarcoma and of embryonic tissue, they being without walls. By throwing out prolongations, and by contraction of the embryonic cell-condition, the connective-tissue cells are formed, and in granulating surfaces which advance to the stage of healing, we find the cicatrix made up of or containing the spindle-cells. These two forms of cells, the one as found in simple granulating surfaces as well as in the round-celled sarcoma, the other as found in connective tissue and in the spindle-celled cancer, have the power of infecting the tissues. In this consists the special malignant characteristic. The apparent presence of the round cells in the spindled-celled tumors is owing to the transverse sections of the interlacing spindle-cells, and is always so regarded.

The nature and character of the lipoma or fatty tumor, the osteoma, and various tumors formed by the admixture of these elements, were referred to by the lecturer. The fibroma was described as a tumor which in itself did not produce any dangerous symptoms, but might, indirectly, by its position. Dr. Seiler was of the opinion that the recurrent fibroma of the English surgeons must be looked upon as an encapsulated spindle-celled sarcoma, and the recurrence *in loco* of the tumors must be explained by the presence of tumor-elements in the tissues outside of the capsule, which elements have the power of reproducing the neoplasm.

The second class of tumors, the epithelial, were then considered. By irritation of the epithelial elements, or when the nutritive processes are actively stimulated, we have an undue development of these cells outward, constituting the form of tumor known as the papilloma or *wart*, the simplest form of epithelial tumor. By the same process, limited by the thick and hardened epidermal layers at a later period of life, the cell-growth extends inward in the direction of the least resistance, and the form of tumor known as the epithelioma results.

The adenomata, or glandular tumors present the appearance of increased glandular elements. The proliferating epithelial cells may however, fill up and enlarge the acini to such an extent that finally the limiting membrane is broken through, and the cells continue to grow into the adjacent connective tissue, where we find nests of proliferating cells, usually of an elliptical form from being pushed forward. When the connective tissue predominates, or is greatly increased in amount, a hard scirrhus cancer will result. If the connective tissue fails to increase, and the epithelial cells develop to such a degree as to wither or overbalance it, then these cells, also breaking down from pressure, etc., form the soft variety of cancerous tumor. In conclusion, the lecturer said that the chief point which he desired to bring before the gentlemen of the Academy was, that there is no such thing as a *cancer-cell*, and that the question whether a cell is malignant or not, depends upon the infiltration of the new cell-growth, the position of the cell-growth, secondary deposits, etc., etc.

Dr. Alfred Reed gave as a reason why the lungs are a favorite seat of secondary cancerous deposits, that they are formed by the same germinal layer of the embryo as the bones.

In reply, Dr. Seiler said that tumors not originally situated in bones form secondary deposits in the lungs, and, on the other hand, tumors of the bones form secondary deposits in other internal organs, and especially in glandular organs. He further said that it needed but a very few of the tumor elements carried to a distant point by either the circulation of the blood, or, as is more frequently the case, by the lymphatic circulation, in order to start a new point of development. In proof of this the lecturer related some experiments lately performed in Germany, in the course of which a few cartilage cells taken from a cartilaginous tumor were engrafted upon the cornea of a rabbit, and also in the muscular tissue of another animal of the same species, which formed the starting-point for similar growths to that from which they had been originally taken.

The lecture was profusely illustrated by diagrams, and by a large number of slides showing the different varieties of tumors and their histological details.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales and purchases for cash must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

To mounters· Large quantities of pure foraminifera, etc., for first class prepared American material · send samples to J. Green, The Cross, March, England.

To exchange, 40 acres of prairie land in Sherbourn Co., Minn., on St. Paul and Pacific R. R., 50 miles from St. Paul, for second-hand piano or organ. James B. Garrison, P. O. Box 122, Georgetown, Texas.

Wanted, well mounted slides, in exchange for a German student lamp. Address H. Watson, 31 Aborn St., Providence, R. I.

A fine Liston's amputating knife, cutting blade 9¼ inches, made by Hernstein, in perfect order, to exchange for a good Valentin knife. W. W. Munson, Otisco, N. Y.

Wanted, tertiary and cretaceous fossils, southern or tropical, marine or land shells and rare minerals, for Devonian, Silurian and coal measure fossils, or N. Y. L. and F. W. shells, Mississippi River, Uniondale or Eastern minerals. B. H. Wright, Penn Yan, N. Y.

Will exchange for well-mounted objects, human teeth sections from any part of tooth desired. H. A. Moyer, Kendallville, Ind.

Slides of pine pollen, so-called sulpher shower, which fell in eastern Pennsylvania, March 17. Diatoms, vegetable stainings, etc., in exchange. C. Henry Kain, 524 Cooper street, Camden, N. J.

Wanted, a good stage micrometer, in exchange for fine diatoms and other desirable material. M. A. Booth, Longmeadow, Mass.

Wanted, an achromatic condenser and fitting, or Wenham's parabolic reflector, in exchange for books on medicine, or state what is wanted, H. V. H., P. O. Box 47, Coeymans, Albany Co., N. Y.

Slides of Nummilitic limestone from Pyramid; foraminiferous limestone, India; deep sea dredgings, various parts; Sertularia. Histological or pathological specimens preferred. Dr. Chas. L. Swasey, New Bedford, Mass.

I have for exchange a Kinne self-centering turn-table with circular table. Clark M. Elliott, Auburn, N. Y.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypens, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Exquisite wild seeds, showing points of family likeness, mounted or unmounted, for exchange. Rev. J. T. Brownell, Lyons, N. Y.

Skin of shark, bryazoa, diatoms from Cape Cod. and other marine mountings, for good mounted objects; lists exchanged. Rev. J. D. King, Chatham, Mass.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Cocoa Bœhm concert flute, made by Badger, of New York, with pure silver keys, cost $100, in exchange for microscope, stand and objectives. J. H. Raymond, 76 State street, Brooklyn, N. Y.

Good pocket magnifier, 1 lens, 1¼ inch diameter, oval, hard rubber case, in exchange for good stage micrometer, ruled into 100ths and 1000ths of an inch. Address F. N. T., Box 243, Greenport, Suffolk County, N. Y.

For exchange, well prepared herbarium specimens from the flora in the vicinity of Chicago. Address Mason Bross, 550 Dearborn Avenue, Chicago.

Diabantite, a newly discovered mineral, and other specimens, in exchange for good cabinet specimens from other localities. A. H. Eddy, Box 696, New Britain, Conn.

THE AMERICAN

Journal of Microscopy,

AND

POPULAR SCIENCE.

VOL. IV. NEW YORK, OCT., NOV., DEC., 1879. NOS. 10, 11, 12.

Proceedings of the American Society of Microscopists, held at Buffalo, N. Y., Aug. 19, 20 and 21, 1879.

REPORTED BY DR. CARL SEILER.

THE first annual meeting of the American, Society of Microscopists, was opened in the chapel of the central school building, on Tuesday morning, August 19th, at 10 A. M. by the President, Dr. R. H. Ward, of Troy.

Dr. H. R. Hopkins chairman, of the local committee then delivered the following address of welcome:

MR. PRESIDENT AND GENTLEMEN:—Let us exchange congratulations upon this. the occasion of the first meeting of the American Society of Microscopists.

I most heartily congratulate each and all of you who have the pleasure of remembering that you assisted in the work of founding this society, and I also congratulate all of you who have the opportunity of attending the first meeting and of enrolling your names among the list of its members. I also ask you to congratulate the citizens of Buffalo, upon the fact that the first meeting of this society is held in our city.

I congratulate you upon the hearty cordiality with which you are made welcome by every member of your local committee and the various societies and associations which that committee represents, and I ask you to congratulate us upon the cheering prospect that our expectations of the pleasure of listening to your deliberations are so near fruition.

Again I congratulate you upon the fact that there is an *American* Society of Microscopists, and I believe that the work of recording what Americans have, done and are doing for the advancement of this department of science. can safely be trusted to the future of this Society. With this thought in my mind I must congratulate you upon the prospect of having with you one who has had the rare good fortune to teach the world how to make objectives, whose angles straddled far outside the limits which authorities had fixed as the boundaries of the possible. Let us give all honor to the modest yet noble American, Mr. Charles A. Spencer, at once the father and the genius of modern microscopy.

Bright and pleasing to me as are these thoughts with which I would welcome you on this occasion, there are others which call for still more hearty congratulations. I sincerely congratulate you upon the nature of the study which this society is intended to facilitate and encourage. The labor of the microscopist is a hopeful labor, and although discouragement and despondency will come to all, although many must fail and but few succeed; yet in the light of the glorious triumphs of the various makers and workers of the microscope, triumphs which within the period spanned by the memory of many now present, have produced the high degree of perfection of our optical and mechanical appliances; triumphs which have given birth to whole departments of scientific knowledge neither discouragement nor despondency can long prevail. But beyond and above the glorious inspiration which history gives us are we not made hopeful by the feeling that the indomitable perseverance and faith which impels the student to strive and seek after new truths, is of itself a sign and a promise, that to some patient seeker nature is still waiting to reveal herself ?

Therefore, I congratulate you upon the nature and character of the work you have in hand, upon the sublime patience, courage and glorious achievements of the fathers—upon the character, the zeal, and the inspiration of your co-workers and upon the organization which gathers all these elements and from them weaves the web of progress.

In behalf of your local committee and the different learned and professional societies which that committee represents, it welcomes you to Buffalo. May your meetings and deliberations be as profitable to you as they will be entertaining to us.

At the conclusion of his address, Dr. Hopkins introduced the Hon. Geo. W. Clinton, President of the Buffalo Society of Natural Sciences, who said in substance:

In common with the gentleman who has addressed you and the gentleman who is to address you, I regret extremely that custom makes it necessary for me to utter any more than mere words of welcome, and touch upon subjects with which you are far better acquainted than myself. I can only say I am glad, very glad, to see you here. I have somewhere seen it stated—I am not sure but that you will find it somewhere in the books upon optics—that the human eye is a very imperfect organ. To me it has always seemed a marvelous one. Perhaps you will find eyes in certain animals that play more perfectly under certain conditions. You will find eyes that see in the dark as perfectly as in the day. You will find eyes that are more microscopic than the human eye. And in a certain sense man's eyes are imperfect. They have come from the hand of the Creator with limitations to their power. But no man has a perfect sense. What would these grumblers ask ? A perfect man in the largest sense ? He would be a perfect monster. Would you have a man that was perfect from his birth ? Why, what a world it would be ? How radically, how constitutionally you would have to change things. It is man's lot, his blessed lot, that he should grow, that he should find happiness in the toil which brings expansion to his faculties. God has endowed man with an intellect, and the labor which aids in the growth brings him nearer to his Maker.

What shall I say of the microscope, the mighty instrument which we come here to study and to honor ? In its simplest form we know that the lens comes down to us from remote ages from the inscriptions which we find engraved upon the gems of the ancients. And what has man's intellect discovered from that simple instrument ? It has given us the telescope by which we have learned volumes from the stars. It has also given us the microscope by which we study the things of the "earth below." And in this study of the infinitesimal it seems to me we obtain a richer knowledge than any we can find in the study of infinite vastness.

Science and art are so intermingled that it is difficult to separate them. And what is microscopy ? Is it a science or an art ? Strictly speaking I should say that it was neither. It furnishes food for all the sciences; it nourishes all the arts. What is hygiene, what is the structure of the human brain if you blot out microscopy ?

I am very glad to see the American Society of Microscopists here. I know that the citizens of Buffalo hold you in high esteem and I am sure your stay will be made as pleasant as possible. Of all the sciences represented here none are more dependent upon microscopy than my own. It is therefor with the utmost cordiality that I bid you welcome.

Dr. Thomas F. Rochester followed Judge Clinton, in the following words of welcome from the medical profession:

There is no pleasanter word to hear or to utter than—welcome. And when, a day or two since, the speaker was designated to say it to those here assembled for the physicians of Buffalo, he felt that he was much honored in being made their representative to discharge a most agreeable duty. It is not, however, as strangers that we meet. There is in science a bond of fraternity at once broad and yet close and cordial. The scholar of one section is affiliated to those of others, however near or remote, not only by common pursuits and investigations, but also by that higher and loftier spirit which is evolved by intellectual progress and developes of necessity a feeling of congenial and fraternal interest towards all who strive to make mind dominant over matter. In addition to these consequences and effects of an educated and elevated intellectuality, there is between you and us a closer and more intimate tie but not a more binding or exalted one—that is, a professional one. A physician must either be himself a microscopist or must have almost daily recourse to one, for the necessary information to practice his profession correctly and conscientiously, not to say successfully. Nothing is hazarded in taking for granted that a large proportion of this audience consists of medical men. The microscope, at first a necessity for professional instruction and information, becomes a delight and attraction which captivates its employer and leads him on and on in the boundless fields of science which it unfolds to him, and illuminates with a beauty of design and structure of which no description can give an adequate idea, and of which the most abstruse thought and the most vivid imagination could never have conceived.

What the microscope has done and is doing for medicine can only be alluded to. By it alone we observe the minute homogenious and wonderful processes by which the human body is evolved from a simple cell to the complete structure we call man. By its information we recognise diseases as local and parasitic which for ages had been considered constitutional. By it the various secretions and excretions of the body are examined, and it alone often determines whether important organs are functionally or structurally disordered. In chemistry, by determining form it often enables the examiner to predict probable properties. These things and many others the microscope has done for medical science. How much more it will do it is difficult to surmise. Your chief reason for gathering here from all points, many of them far distant, is to extend the knowledge and to promote the use of microscopy. Such meetings apart from their delightful social elements, must afford you great pleasure and information, and by every advance you make is medicine correspondingly aided and elevated.

The late Valentine Mott, in his day the most celebrated of American surgeons, designated for himself a coat of arms, the subject being a closed hand with the forefinger extended and terminating in an open eye, indicating that his touch was so delicate and correct that it gave as positive information as vision. But what is this to the microscope; which metaphorically covers us with eyes, which penetrate into the hidden depths of nature and bring out for our instruction and delight visions of wonder and of beauty and of power? As confreres, and as the promoters of this Science of Sight, again welcome, and thrice welcome.

The President, Dr. R. H. Ward, in response to these addresses of welcome said:

It is no common pleasure to be able to receive and accept the welcome to this Society extended by you, and through you by the citizens of Buffalo; and to give voice to the reciprocation by our members to your words of courtesy and appreciation. We meet you under peculiary pleasant circumstances. Those of us who had the pleasure, some years ago, of attending the Buffalo meeting of the American Association for the Advancement of Science, will never forget that meeting as distinguished not only by its high scientific standard, but also by the cordial, thoughtful and delicate hospitality which made the week memorable. And from the prompt acclamation with which the invitation to meet in your city at this time was accepted last year, I fear you really have acquired a reputation which will some time be troublesome. But for all this we have been pleasantly disappointed this summer. We expected the careful and convenient arrangements which your committee have made for our comfort and our work; but we never dreamed of their supplying us with the coolest, not to say the coldest, weather that was seen in the midst of dog-days.

In one other respect our position is peculiar. Our Society is in its infancy, only one year old, and just learning to walk. But though small in years, its size is considerable, its members numerous, and those who are interested in it represent not only the various centres of scientific culture, but also the most quiet and secluded nooks in the country. We are brought together by an enthusiasm almost unknown in any other branch of science. We are stimulated by the study of those little things which lead a philosopher to call God great in great things, greatest in the smallest.

We meet with the expectation of a most profitable session; and we thank you heartily for your interest and encouragement.

The business of the meeting was then taken up, and as the Secretary had not yet arrived, Dr. Seiler of Philadelphia, was on motion appointed Secretary *pro tem.*

In the absence of the Treasurer, Mr. Geo. E. Fell, of Buffalo, was also on motion appointed Treasurer *pro tem.*

The election of new members and the registration of old ones then followed.

Finally a discussion arose as to the best method of publishing the proceedings of the Society and the question was referred to the standing committee, with order to report at an early day.

The meeting then on motion adjourned until afternoon.

AUG. 19.—AFTERNOON SESSION.

The meeting was called to order at 3 o'clock, and after the election of several new members had been announced, Prof. D. S. Kellicott, of Buffalo, read the following paper, which was illustrated by enlarged drawings:

OBSERVATIONS ON LERNEOCERA CRUCIATA.

Mr. A. M. Norman, in the *Zoologist* of London, in 1864, remarks as follows: "Little has been done, as yet, in Great Britain among the external parasites of fish. The only work that treats of them is Dr. Baird's 'History of the British Entomostraca.' It is fifteen years since the statement appeared, and yet it has recently been repeated in substance by a writer in *Hardwicke's Science Gossip*, and it applies with equal or greater force to the state of our knowledge, and to our literature of these strange creatures; while observations, researches and papers have appeared concerning higher forms of crustacea, those treating of these lower forms are characterised by their poverty. Few species have been described, especially among such as are parasitic on our fresh water fishes, while the habits and history of still fewer have been published. In this paper, I have attempted to state briefly the results of my study of the species *Lerneocera Cruciata*, of Le Sener, prefacing it with some general remarks about the group.

"Of all the curious creatures which the naturalist meets with in his researches," says Dr. Johnston, "there are none more paradoxical than the *lernæ;* none which are more at variance with our notions of animal conformation, and which exhibit less of that decent proportion between a body and its members which constitutes what we choose to call symmetry or beauty." This *outre* appearance pertains to the female only, for the male is of as "decent proportion," as beautiful in outline, and as graceful in its movements as most others of the numerous forms of the free *copopeda;* and this also of the females, not until after they have passed some time, equally with the males, as free-swimming crustacea. In the mean time, having undergone at least two moults, it is not until they reach maturity, the chief end of existence then being the perpetuation of the species, that they undergo the wonderful change which naturalists have been pleased to call a retrograde development. To the species of the group to which our lernæan belongs, the expression must apply if at all. Instead of the free-swimming, active individual, the female becomes fixed, the head and upper part of the thorax with the thoracic appendages, are buried beneath the skin and muscles, or other soft parts of the host, depriving her of the slightest power of locomotion; in fact, the females are so modified by the loss of apparent articulation and reduction of external organs, that they were classified with worms until the observations of M. Surriray and Alexander Nordman; the former in 1822 discovered the true nature of the external egg tubes, the latter, a little later, traced the life history of one species; since the appearance of the works of Milne Edwards and Dr. Baird, their place among the *crustacea* has been generally understood. They certainly afford a remarkable example of adaptation of means for securing ends; an example of as complete passivity as it is possible to find amongt animals.

The adult female cruciata is a parasite upon the rock bass (*Ambloplites rupestris*), taken in the great lakes and tributaries. The species was described by C. A. Le Sener from specimens taken at Erie, Pa., in 1824, in the Journal of the Academy of Natural Sciences of Philadelphia. His description is as follows: "Body rectilinear, clavate, terminated by five tubercles which are rounded behind; head armed with four subcorneous appendices in the form of a cross and a little curved before."

Besides the formal description, he states some facts and conclusions. I will introduce these: "Body slender toward the head, and gradually dilating behind, and so transparent as to exhibit the interior parts distinctly. At the extremity of each of the head appendices is a small, black, impressed, somewhat oblong point, which may be an opening communicating with the interior. The intestinal canal extends the whole length of the body without folds or dilations, but gradually enlarges towards the posterior extremity. At a distance of about two-thirds the length of the body from the head, an annulated vessel originates and passes downwards on each side of the intestinal canal; this double vessel seems to unite at its superior part. The conformation of this vessel seems to indicate it is an ovary, there being no appearance of such appendices to the posterior part of the body as exist in that of the following species: *L. Radiatia* and *L. Blainvillii*, and which probably perform the function of branchiæ. I have been led to suppose the existence of other openings in the tubercles through which respiration may be effected."

Concerning the transparency of the body walls, I observe that the older individuals are not sufficiently transparent for advantageous study of living examples; that the chitinous exterior, together with the external load of confervæ and infusorial life which they usually bear, render them too opaque for satisfactory examination, but a young specimen, *i.e.*, one having recently completed its final change, is beautifully transparent. It was from such that I was able to make my drawings with the camera, of the body, thoracic organs, and external ovary. With regard to the small, black, impressed, somewhat oblong point at the extremity of the head appendices, I must say that I have sought for it, without finding it, or anything else which could have been thus characterized.

There is no doubt that the "annulated vessel originating two-thirds of the length of the body from the head end, is the ovary," or rather, as they do not appear to be "united at the superior part," they are the ovaries; by a reference to the drawing it will be seen that they originate at, or reach to, about the middle of the body, and are at their anterior extremity, folded back upon themselves for about one-third their length. For the distance they are each doubled, they overlie the intestinal canal, and sometimes each other, which fact, no doubt, led to the expression, "unite at the superior part." Under favorable circumstances, the ova which give them their annulated appearance, may be well made out. The absence of "appendices to the posterior part of the body" was due to an accident, for they are, as is well known, the external ovaries. I have at different times taken several females of this species with well-filled egg-sacks; still a majority of the older ones taken in July and August are without them, while those fertile ones taken at mid-summer have the eggs loaded with algæ and infesting infusoria. So I suspect the most favorable time for studying the embryology is in Autumn or Spring. The young specimens used for drawings afforded a clean pair of egg-tubes which I describe as follows: Length .083 inches, greatest width .018 inches. The outline is fusiform, slightly curved inwards. There are about eight rows of eggs at the widest part, but two or three at apex. (Fig. 2.) The place at which the parasite attaches itself to its host, is on the sides of the body; the majority occurring on the tail third. It is fixed thus: The body of the parasite issues from beneath a scale, or at the angle between two; the upper surface of head and thorax resting close beneath the skin, with the under side of the head, the mouth and appendages, together with the thoracic appendages resting next to, or within the flesh of the fish; about one-third the length of the body is inserted into the muscle, a *contraction marking an articulation and bearing a pair of appendages*. marks the point to which it is concealed. This oblique setting, together with the freer motion of the articulation, permits the body of the parasite to rest close to that of the fish when it moves through the water, exposing it less to injury from violent contact with objects.

After removal from the fish they exhibit little motion. The appendicular organs continue to move, and the intestinal canal continues to pulsate for some time; I have observed it twenty-four hours after removal. The alimentary canal, as said by Le Seuer, can be traced from mouth to anus; it is a tube without folds, but somewhat dilated posteriorly. I am unable to detect accessory digestive organs. It contains a black granular matter, more apparent anteriorly. The canal is surrounded by a light, fine, granular mass showing here and there oil globules; this mass moves back and forth with the canal, as adjacent parts of it thus move with the pulsations; from the beginning of the ovaries to the head, this matter seems to fill the space between the canal and the body walls. In a fresh individual, I observed the pulsations took place once in five seconds.

It still remains for me to describe the appendages of the head and thorax. I will begin by referring to the last pair: Fig. 4.—This pair stands on the underside of the posterior border of a segment at the most constricted portion of the neck. Fig. 1, 2.—They consist of a basal portion, protopodite? Fig. 4, A.—On which stand two lamellar organs which I designate as endopodite. Fig. 4, C.—And expodite. Fig. 4, 6.—They are each three jointed and bear long plumose setæ, for the detailed arrangement of which I refer to my drawing; underneath the posterior border of these so-called head appendages is a similar pair. Fig. 1, X.—Beneath the centre of the head stands another pair quite like the other two. Fig. 1, Y.—This pair is, however, smaller, and the two are closer together; they are but a short distance back of the pair of foot jaws. Fig. 5, F.—At the base of, or just below the mouth parts. These three pairs seem to be quite analogous in structure to the swimming feet of free *copepoda*. Their use may be to force from the wound such matter as the irritation produced by the action of the parasite may cause to settle there.

The mouth appendages are arranged about a conical body, corresponding to the head, as I think, among higher forms; in the median line at the apex of the head; when under the compressor, it is bent under and then is directed backwards. I have been unable to confine it in any other position so as to sketch it. This cone ends in a blunt point at the opening of which certain hooks appear which I suppose represent the mandibles, although quite different in form from those parts in higher forms. On either side of the cone stand two organs which I take to be the first and second pairs of antennæ. I describe them as follows: First pair. Fig. 5, A. Three-jointed, the first joint as long as the other two which are equal to each other; for arrangement of spines, refer to the drawing. Fig. 5. The second pair. Fig. 5, B. Is two-jointed; joints equal; setæ at the termination long and hooked. Below the mouth opening, but reaching to it, is a pair of foot-jaws. Fig. 5, F. The articulations of these organs are hard to make out; the last joint bears at its apex five strong hooks; at its base is a thumb-like projection, and a styliform appendage. The specimens used in my observations were taken from rock bass taken in the Shiawassee River, the Upper Saginaw, at Corunna, Mich. About one-fourth of the fish taken had one or more of the parasites.

This paper was discussed by Prof. Tuttle and the author.

Prof. Tuttle, of Columbus, then made some remarks on the minute structure of the spinal cord in marspobranch fishes, during which he called attention to the peculiar distribution of the grey and white matter in these fishes.

His remarks were discussed by Dr. Seiler and Prof. J. Edwards Smith, the advantages and disadvantages of the freezing microtome being the chief points in the discussion.

A letter from the Mayor of Buffalo was then read, inviting the members to inspect the public buildings, which was accepted and a vote of thanks tendered to the Mayor.

A vote of thanks was also tendered to Mr. Charles Fasoldt, for the donation to the Society of a slide of his fine ruling. After this, the meeting, on motion, adjourned.

In the evening, a large audience assembled in St. James' Hall to hear the President's address, which read as follows:

MEMBERS OF THE AMERICAN SOCIETY OF MICROSCOPISTS—Since this is a new Society, as yet without a history, a policy, or a thoroughly organized membership, it is believed that an informal address, in a popular form, in regard to the position and objects of our society will be more timely and useful than such a technical report of original work as would usually be expected in a President's annual address.

The formation of this society, and the presence of this audience here to-night to welcome its first public meeting, brings us to the contemplation of a branch of science, insignificant in years, trivial in respect to its means and objects of study, but great in its accumulated results, and in its record of influence exerted upon the recent progress of human thought and the development of modern science; a department of learning almost every step in whose progress has been a revolution. It is scarcely more than a hundred years since an enthusiastic friend of the microscope announced certain improvements in the instrument as rendering it "agreeable to the curious." It is within the memory of persons now only in middle age, that a majority of people still considered the instrument merely an elegant toy, that an author who brought one to this country at a cost of $1,000 was derided for his foolish expenditure, and that the high price of superior English instruments was repeatedly and formally stated as the reason of their limited sale in this country—where they are now commended by their cheapness compared with those manufactured here. It is only thirty or forty years since the English opticians, both theoretical and practical, began the development of the really modern microscope, a work in which they were soon aided and sometimes surpassed by their friends in France, Germany and this country. It is about the same length of time since the brilliant discoveries of Ehrenberg spread abroad from Germany, fascinated the naturalists of England and this country, and taught the whole world the possibilities of the new means of research; yet in those few years an amount of work has been done which it is the labor of a life-time to review. A dozen years ago the microscope was so complete and satisfactory that some admirers considered it to have reached its limit of practical improvement. One author called it the only perfect instrument, by which it was meant that it was the only instrument of human construction whose performance equalled its theory, whose adaptations to its objects left nothing further to be desired, in whose contrivance or execution human science had nothing further to ask from human art. Yet every succeeding year must have been a surprise to such an author; the perfect instrument has become more perfect, though it is manifestly faulty still; the stand has been made less clumsy but more steady, less complicated but more convenient, less showy but more durable, less costly but more useful. The objectives have been improved in definition, greatly increased in available aperture, and supplied with far better appliances for cover-adjustment; the immersion system has become universally introduced, its use extended to the means of illumination, and the advantages of a literally homogeneous fluid recognised; the binocular arrangement has grown from an experiment of disputed value to a priceless luxury if not a literal necessity; means of illuminating at definite and known angles have become available; the spectroscope, and the sensitized plate of the photographer, have become powerful accessories; and the instrument of which that proud remark was so lately made, has already become absolete and grotesque, one of the curiosities of history rather than an instrument of precision well fitted for delicate scientific work.

Still more recent and sudden has been the evolution of our extensive system of microscopical societies. Of our thirty societies many have been formed during the last two years, a large number originated in 1874 and thereafter, and scarcely two or three outdate the origin of our Troy society in 1868. As late as 1874, when I first collected those particulars in regard to the societies which were published early in 1875, so little public attention had the movement commanded that data in regard to them were collected with much difficulty and delay. Many of the older organizations are still strong and active, and many of the newer bodies are now large, and energetic, and full of life; and I hope that one of the direct results of the foundation of this general society will be the birth of new local associations in those centres of scientific culture where they are still wanting. (Perhaps this cause may be believed to have had something to do with the new arrival in Detroit within the last few days.) Residents at those localities should not hesitate from want of experience or doubt of success; but should consider the present time the best time and act accordingly. It is easy to row with the tide, and the tide sets that way. Microscopy is in favor now, and societies are popular, and some of the newest of them have already surpassed in size the eldest. It is not requisite to affect much learning, incur much expense, or wait for the support of a crowd. In any community, however unscientific, where there are a few persons so intelligently interested in the microscope as to use it with advantage, and sufficiently homogeneous to take pleasure in associating together, if those persons will but meet together, with their instruments, statedly and systematically, for such work in this department as may correspond with their tastes and qualifications, the formation of the society, whatever they may call it, will not only be possible but actually accomplished; and if they will take the trouble to interest and encourage beginners, and without arrogance or clannishness, to make welcome as members all who are likely to be really useful, the work of building up the society will thereafter take care of itself. How often such a society should meet will depend upon the amount of leisure, and of scientific and literary activity of its members. A few good meetings are far better than many poor ones; yet too long intervals tire out the enthusiasm of the participants. The experience of our American cities seems to teach that meetings should usually be held either once or twice a month. How far the society should be popularized, how formal should be its meetings, and how distinctly literary its proceedings, how prominent a place should be given to the mere exhibition of instruments and objects, and how freely, if at all, intelligent persons not especially cultivating this branch of science should be made welcome as visitors, will depend almost entirely upon local considerations, which can be best judged by those who are familiar with the ground, especially by any who have the advantage of experience in the organization and direction of affairs. It may be said, however, that it is safer, as well as more generous, to err on the side of liberality than of exclusiveness; that such societies, like plants, are very likely to grow best in the light; and that science can be best cultivated by the few when it is best understood and appreciated by the many. It should also be remembered that a scientific society or club is not a school to be bedrilled by one or two pedagogues, nor a lecture association to be regularly addressed, from above, by a few professional lecturers, still less by the same number of amateur instructors, but a body of members affiliated by community of tastes and purposes, who meet on an equal platform for mutual work. Of course, they will recognise as leaders those among them whose intellectual discipline and experience in affairs would render them indispensable as guides; but they will be induced, unless those leaders prove wanting in judgment or in tact, to feel an active interest and mutual responsibility in the work of the society, whatever that may be. And the standard of work in the society, even though it should therefore be less formal or intellectual than would please a few, should not be set too high to secure the free and somewhat equal participation of the membership generally. The members, if intelligent, will appreciate wisdom and experience, and the power to direct, none the less because it takes the form of an associate and not of a director; and the leaders can afford to be generous if they are qualified to be at the head.

It is as easy to found a general as a local society, but not so easy to secure its permanence. Our infant society, the first anniversary of whose birthday we celebrate to-night, begins its life at a time most fortunate. Never before could it have been born with half the present chance of life. The favoring circumstances seem strong, and the hindrances those only that are inherent in the circumstances amid which it must live, if live it can at all. We enter the field with courage and enthusiasm. Success seems to be simultaneous with effort. The first meeting was equal to our hopes; the second surpasses the first. But we must realize that the magnitude of the project involves the most serious responsibilities. To justify its name, an American society must *be* American; it must be neither meagre nor local; it must have a large, active, and permanent membership, well distributed among the various sections of the country; it must include names of recognized ability and influence, and must be really representative of American microscopy; it must be a power as well as a name. To make it feeble would be a failure, to make it local would be a farce. Yet the obstacles in the way of success are such as might well check any faith, but the enthusiasm of youth. Distances are great, in this country, and not all men of science are men of wealth or of leisure. Many persons of distinguished qualifications for membership have written, this year, that distances are too great, and that the time and expense involved will prevent their participation. When I remarked to a London friend, at Philadelphia, during the Centennial summer, that I should be at the meeting of the American Association for the Advancement of Science in this city, the next morning, adding that the plan of meeting so near was favorable, as it enabled members both to attend the meeting and to visit the Exhibition at Philadelphia during the same trip, he looked puzzled, and replied that he did not think Buffalo near, they would consider it a great way off in England. Furthermore, it is well known that some who can give the time to attend distant meetings, have other plans which, unless they can be harmonized, will stand more or less in the way of this. The practical questions, then, of how often these meetings should be held, and over what range of territory, and by what means a steady and adequate attendance can be maintained after the attraction of novelty has ceased to act, and the tax upon time, and thought, and money, has become felt, should receive the most serious and deliberate consideration, and all the aid that can be derived from the experience of others, in order that our plans may be wise and our success permanent.

The interruption to the mailing of slides on account of legal technicalities, which has been a subject of prominent interest during the past year, has just reached a satisfactory settlement, of which it is a pleasure to now make the first public announcement. The old law forbade mailing glass or objects packed in glass; and as applied to the objects for which it was intended, its wisdom was not questioned. Probably its authors never thought of the little subject of microscopical slides, and the inconvenience to scientific students which would result from interruption to their transit through the mails. It was evident from the first that difficulty might possibly arise by literal enforcement of the law, and that relief must be sought from Congress, and not from the Post Office Department. It needed no official decision to establish that glass slides were made of glass, and an appeal to the Department could only compel them to obstruct a privilege which had always been practically enjoyed without thought of conflict with the spirit or intention of the law, and without a single complaint of injury done or feared. When the American Postal Microscopical Club (originally named Micro-Cabinet Club) was organized for the purpose of cultivating microscopical science by interchange of written communications and objects through the mails, and with a membership distributed throughout the United States, its officers brought this subject before prominent members of Congress and received assurances that the interests of science should not be overlooked, and that the desired objects could doubtless be attained without objection when the postal laws should next be revised. As yet no inconvenience, save occasionally a local and trivial one, was experienced, as the post offices generally allowed the slides to pass without fear or question. But during the last winter public agitation produced the inevitable result of forcing an application of the law to this case, of rendering the mailing of slides improper and impracticable, and of abruptly suspending the operations of the Postal Club. Meanwhile a new postal law has been prepared and is now in force. At the request of scientific men, and without objection, a clause was inserted in that bill, allowing the Postmaster-General to decide without constraint in regard to the safety of such postal matter. It was supposed by many that this settled the difficulty at once, but the new regulations, made public three months ago, required objects packed in glass to be contained, for double security, in a suitable case which should be itself inclosed in an outer case of metal or hard wood. Some further delay was experienced in obtaining a case which should fulfill these conditions to the satisfaction of the Department and without too much expense or weight to answer our purposes. A package just received from Washington, and which meets the approval of the Department, will show a perfectly feasible manner of packing slides for mailing, with the certainty of official approval at headquarters. This box is wrapped in a strip of thin sheet brass, which may be used an indefinite number of times. The added weight and expense are not large and the trouble not greater than that from paper wrappers. The inner case, in this instance, is the regular box lately exclusively used by the Postal Club. It is like the common racked boxes, except that it is packed with cloth in the manner devised by myself two years ago, every part of the slide except the centre where the cover-glass is situated, being supported by a thick layer of soft cloth. Since the introduction of this method the loss of slides by cracking has become almost unknown. As a result of this adjustment of the postal difficulty, steps are now being taken for the immediate revival of the Postal Club. [Box shown].

One of the most important questions, theoretical and practical combined, which is now fairly before the microscopical world and still is in an unsettled state, is that of gaining definiteness and uniformity in *micrometry*. In this field emergencies have arisen during the past year which have compelled me to take considerable responsibility, as well as to perform a large amount of work, trusting that the generous approval of my colleagues would accept and ratify what seemed at the time, and what seems now, most consistent with the interests of science and the dignity of this body. It will be remembered that a year ago, just at the close of our Indianapolis meeting, resolutions were offered favoring the adoption of the metric system for micrometry, and the one hundredth millimetre as the unit to be employed, inviting foreign co-operation, and accepting an offer of standard micrometers from Prof. William A. Rogers, of the Astronomical Observatory of Harvard University. None of these points, save the last, were new or unconsidered. They had been studied at leisure for years by many members who were present. The metric system had been adopted by all the civilized world except Russia, England and the United States; and its universal adoption was, as a rule, earnestly desired and favored by the educated scientific classes. It has been adopted, or recommended after mature deliberation, by the National Academy of Sciences, the American Metrological Society, the American Association for the Advancement of Science, by the American Society of Civil Engineers, the United States Coast Survey, the United States Marine Hospital Service, the American Medical Association, the Congress of Opthalmologists, and by the largest State and local medical societies, and by leading medical schools, and journals, by numerous boards of education, college faculties and local scientific societies, and by experts in various branches of science and art. On the other hand the resolutions contained some minor faults, mostly in matters of taste or tact, which could have been easily remedied by reference to a committee. But there was no time for reference or for adequate discussion, and rather than discourage their object by failure or postponement, they were adopted and referred to the local societies for consideration. They were passed unanimously, at a small session, it is true, but by the same vote which established this society and authorized its meeting here to-day. As too often happens, their incidental faults attracted more attention than their really scientific object. The unit proposed was evidently too long for integers and too short for fractions, and unlikely to receive a single approval either at home or abroad; the proposal of international action, though its object was universally approved, was in a form not likely to accomplish that object; and the liberal offer of Professor Rogers was wholly misunderstood and perverted, until it took the form of the preposterous statement that it was proposed to make Prof. Rogers' micrometers standard as distinguished from those of other (!) makers, not the least amusing of all the blunders and absurdities of this precious statement being the association in any manner, of trade rivalry or mercenary considerations with the work of one of our most generous scientists who has freely shared with the public every result of his labors, while spending thousands of dollars upon his investigations without a thought or a possibility of ever seeing the money again. It soon became evident that an organized treatment of the subject was required to secure a proper and unprejudiced discussion of the objects of the resolutions. Feeling much responsibility, as the presiding officer of this society, and of one of the oldest of the local societies, but having no authority to appoint an evidently necessary committee that should represent not only this society, but also sections of the country not yet named upon our rolls, I brought the subject before our local Association, and we invited all the societies that could be reached to join with us in the selection of a National Committee for the consideration of this subject. The response from the larger and active societies, and from distinguished individuals, was a cordial and almost unanimous approval. Many of the societies nominated to the committee members distinguished as specialists in this branch of microscopy; both societies and eminent scientists contributed valuable opinions upon all the points at issue; and a large committee was organized which will at a proper time tender a report of progress to this society. And while speaking of this committee, I will take the liberty of saying that it would be a pleasure to me, and I doubt not to all of us on this side of the Lakes, if our friends from Toronto or Montreal, or any other points in the Dominion which may be represented here, would nominate members, and thus make it an American instead of a national body. To prevent confusion or misapplication of the practical suggestions which follow, and which naturally belong to this time and place, it is necessary to anticipate the report of the committee so far as to say that it will recommend to this society to rescind its approval of the 1-100th millimetre as the unit for micrometry, and to so modify the form of the other resolutions as to leave the important questions of accurate measurements and convenient and scientific nomenclature in a favorable form for the attainment of valuable results.

Whether this society, as such, shall continue to be known as actively interested in this reform, it is for you, not me, to say; though I sincerely hope that the members will unanimously agree with me in judging that it ought to do all that its influence, without dictation, can do in this direction. But I for one do not deem the decisions of societies or other corporate bodies decisive and final. I am not much elated by their approval, or discouraged by their opposition. I have an average amount of respect for the motives but not for the efficiency of legislation. In State, in church, in science, it is possible and easy to carry out laws about in proportion as they are unnecessary. People who do not need government are easily governed. Persons who appreciate authenticated micrometers will use them if they can with or without the approval of societies; and those who do not desire them will be about as little controlled by official decisions. While the encouragement and support of societies and of officials is welcome and valuable as far as it extends, I have more faith in the power of individual influence, and to that I look for an example which is able to settle this question beyond appeal.

In our micrometry we have the anomaly of a system of work capable of a precision almost if not quite unknown elsewhere to human art, for what other wholly artificial procedure possesses a demonstrated limit of accuracy inside of the 1-300,000th of an inch, and yet, until now, we have made no reasonable effort to free ourselves from avoidable errors known to be many times larger than that amount. While coal at $4 a ton and muslin at six cents a yard are, or at least pretend to be, measured with apparatus that has been carefully verified by standards of known quality, we have been measuring spaces almost infinitesimally small by standards of only commercial quality and possessed of manifest and uncorrected errors. This fact is too suggestive of the days when micrometers consisted of grains of sand, and clippings of wire; with the odds against us, that we know how to do better. Arrange your microscope so as to magnify 3,000 or 4,000 times, making the one-thousandth of an inch on the stage seem three or four inches long through the lenses, then arrange an ocular micrometer so that the magnified one-thousandth of an inch shall be covered by, for instance, one hundred divisions of the ocular scale, and finally ascertain exactly how many of the one thousandths of an inch on that or any other plate will be similarly measured by precisely the same one hundred divisions above it. Judging from my experience and that of others who have tried the experiment, you will probably find a perfectly measurable discrepancy between the different spaces of the same name; so that even your own measurements, with the same apparatus, will not be comparable with each other unless, as often done, you select some one average space as a basis of comparison, and are careful to use only that. Now we are trying to ascertain which of these various spaces is the correct one; or if not one is right, then to obtain one that shall be; or if that cannot be done, at least to determine a known error from which we can compute definite results. This is not a question of makers, or dealers, or trade interests in any form, but of unmixed and independent science. We are attempting to procure a standard because we need it, and we hope for the cordial assistance of microscopists of really scientific spirit in the difficult work of attaining it, and in the almost equally important task of bringing it into general and respected use. I call this a standard for convenience, and not in a strict or ultimate sense. Strictly it is only an authenticated copy of a standard, or portion of a standard, namely, of the world's standard metre or standard yard; and hence the importance, not fully shared by the original metre itself, of its corresponding perfectly with its theoretical length.

The adoption of the metric system has a formal sound, and its difficulties have been, to say the least, well represented. But, to the extent of its use in micrometry, it really presents no difficulties and many advantages. The value of the millimetre and its decimals must be made familiar to the mind for other purposes, even for the understanding of exclusively English literature, and to use it for our own measurements and statements will merely assist to keep it fresh in mind. The English system, or rather tradition, presents no pair of units so convenient for the microscopist as the millimetre for large objects and the 1-1000th millimetre for small ones. For the purposes of most people, for use in micrometry alone, it is sufficient to remember that the millimetre is about one-twenty-fifth of an inch, and surely that is no great intellectual task. Nor would it waste a large portion of a lifetime to learn the whole series from the metre down, remembering that, in round numbers, the metre is a yard, with three or four inches to spare, the decimetre one-tenth of that 40 inches or 4 inches, the centimetre one-hundredth of that 40 inches, or 4-10ths of an inch, and the millimetre one-thousandth of that 40 inches, or 4-100ths or 1-25th of an inch. The real difficulty lies, I believe, not in memorizing the value of the few new units required, but in the awkward and useless habit of stopping to translate every item from the new unit to an old one. Any one can add a few new words to his vocabulary, a few new units to his tables, without harm. The telephone and the phonograph have brought no disaster along with their new double Greek names. An educated person can learn in an hour all the new terms, values and proportions of the whole metric system, with its interesting and suggestive relations; and the time would be well spent though he never used the system again. But I also know by experience that he can also use it again easily. When you once learn by a little practice to think in the new units the same as in the old, the apprehended difficulties vanish unaccountably and can scarcely be brought to mind again. If asked to estimate the width of this room in yards, only a child unfamiliar as yet with the practical use of measures would say to himself, "It seems to be about 90 feet, which would be 30 yards." You would rather look at the wall to see how many times longer than a yard it is. So if you will take a metric rule, learn well how the millimetre looks, and its dec. the centimetre, and learn to use it in measuring and estimating the size of suitable objects, such as insects or flowers, you will find it as easy to think in millimetres as in lines, inches, feet, or yards, to say nothing of the comfort of knowing that you are in no danger of being lost between several kinds of the same name.

Aside from the selfish though sufficient motive of our convenience, I hope we shall practically adopt the metric system, because we can thus contribute a trifle of influence towards its general introduction. It seems plain enough now that our country made a serious mistake in not adopting it at first; and I am satisfied that it is still best for us to use it, notwithstanding the greatly increased difficulties in our way. It is not questioned that this is the best system ever tried or proposed, and the only one that can possibly come into general use; it is not denied that it would simplify education, and substitute order and intelligible relations for the confusion of our present metrology; it possesses as many points of convenient relationship to our old system as could reasonably be expected in any new one; it is admitted to be excellently adapted to all scientific work; it has been satisfactory to mechanics and manufacturers who have actually used it; it has been gradually and completely introduced into large shops using costly tools and machinery, without serious expense, and to the satisfaction of the managers. Almost without exception its friends are those who have used it, and objections to it come from those who have not. You hear less of the evils it has caused than those it would cause. Furthermore it offers us a carefully elaborated scheme of international co-operation, which we have but to adopt in order to place ourselves in harmony with the rest; the metric system is all international. It also unifies almost entirely the records made by persons adopting different units, since a statement of size will be practically the same to the eye and to the ear, and will require no formal mathematical reduction, whether made in centimetres, millimetres, or in decimals of a millimetre. Fortunately we have all tried the experiment for ourselves, in one department, and know what some of the objections are worth. Our system of currency is precisely like the metric series of weights and measures, and is marked essentially by the same evils and benefits. Who now believes that having adopted a currency incompatible with the English system has caused us a hundredth part of the trouble it has saved, notwithstanding that it lacked the advantage of putting us in harmony with the rest of the world? Who now feels cut off from the past because of the change, or regrets the loss of the pounds and shillings so long as he has dollars enough, and of the right kind (it is not easy to satisfy everybody about that)? Who has found the poor oppressed and the laboring classes annoyed by the system we adopted? Who has yet incurred a burdensome expense in hiring accountants skilled in a foreign and to us obsolete nomenclature to compute from the records of the past how many pounds, shillings and pence our grandmothers paid for their bonnets, or our grandfathers for their ships or their farms? The truth is the new system is so much better for our present purposes that we are glad to use it as soon as we fairly know how; and I believe that the same would be true of the whole metric system. We do not undervalue the records of the past with their elaborate computations, and tables, and surveys; but few of the people of to-day come in contact with these directly, and those few could afford the extra trouble for the sake of the far greater interests involved. It is not scholars to whom learning in an unfamiliar form is a terror; they will spend lifetimes in working over such lore, merely for the pleasure of the work. And so much of it as is required for use in the daily life of the illiterate world is constantly modified, and modernized, and adapted, by specialists of various kinds, who inherit the progress of the past but adopt the fashions of the present.

To adapt a homely phrase which has remarkably vindicated itself, in another field, in recent history the proper way to introduce the metric system is to introduce it; not to decide why others should use it, but to use it ourselves. Nor need we not wait to be certain of the feasibility of securing its universal use. It may be profitably used in science though not accepted in trade. The chemists have adopted it fully and with satisfaction in their work, in their teachings and in their books; the physicians are adopting it in different parts of the country, and the microscopists may well enjoy its facilities whether others do so or not.

The most important suggestion to be made in respect to the use of the microscope is—not to forget to use it. The instrument itself is brilliant and attractive, and a refined taste and cultivated appreciation of the beautiful may well derive pleasure from familiarity with its exquisite brass-work and its subtle optical refinements. But the love of the instrument is liable to make us forget that it is partly a tool and not wholly a toy. Unless intelligently careful to avoid it, we may fall into the folly of becoming men of magnificent preparations, but unimportant results; of forever getting ready to do nothing; of accumulating a vast quantity of exquisite material, which shall be lost to the world as soon as we possess it. An illustration from a less familiar object, not associated with our own habits and possibly with our own mistakes, will best explain this difficulty which is at the bottom of nearly all the prejudice that really exists against our specialty, and which has led some perhaps too hasty critics to object to the very name of microscopist. Suppose a person to become fascinated with the ingenious construction of a nut-cracker. He likes the kernels that are hidden in the nut-shells, but is far more pleased with the method of getting them out. He studies up the transmissions and resolutions of forces by which the power of his hand is applied to the useful purpose of disintegrating the stony pericarp of the tempting fruit. He knows the qualities, the advantages and disadvantages of the different material used in constructing the crackers. He can tell, to a day, when the different styles were invented and patented, and by whom. He has the merits and faults of every maker at his fingers' ends, and he knows whose style of manufacture is best adapted to every kind of nut. He has a faultless collection of nut-crackers, and of nuts to try them on; possesses nut-crackers of brass and iron, of bronze and of steel, and possibly one of solid silver; has them furnished with handles of mahogany and rosewood and maple, and covered with leather or cloth, or not at all, as the most discriminating judgment should dictate, and finished in every style known to art. But with all this preparation, he never cracks any nuts; unless incidentally, and for the sake of showing how the machines work. A child with a hammer and a stone, and a sharp appetite for meats, might teach sages a lesson here. Of course somebody must devise improvements to the apparatus if they are to be made at all; but this devotion to the instrument, as such, is more likely to be overdone than neglected. Yet I would not, even by implication or omission, disparage the use of this instrument as a mere recreation. I am a strong believer in the value of amusement, and in its importance to individuals somewhat in proportion to the weight of the responsibilities of their more serious life; and I know not a more worthy toy for the entertainment of a thoughtful person than the microscope. Many of the most cultivated and distinguished men use it as a recreation, and do well; but they are intellectual and scientific spirits who use it as a toy; they are not either intellectual or scientific because they so use it. It would save a vast amount of wasted energy and lost opportunity if there were a clear appreciation of the difference between microscopy as a play, and microscopy as a science. It is most common and most desirable to combine the two, provided we are not thereby misled.

What may be called the scientific uses of the microscope were earlier cultivated, and have become more fully developed and appreciated than its practical ones. The instrument had revolutionized the sciences of Zoology and Botany, and made great contributions to paleontology before its application to the practical needs of civilization had been fairly attempted. Nor is it to be regretted that the higher and more noble field was occupied first and received the most and best work.

But lately the *practical* applications have been made prominent, and they constitute a field attractive, comparatively little worked, and where labor that is original and really valuable, is certain to be appreciated. The study of fabrics and the different articles of commerce, their various qualities adulterations and substitutions, is a field as fresh as it seems to be pre-occupied; the exhaustive work of Hassall, which would be discouraging if recent, does not apply to existing facts, and the work of to-day is still to be done; and it surely needs to be done when adulterants are adulterated at wholesale, and microscopic specimens themselves falsified for the purpose of trade. The interest sure to attach to such work may be inferred from the attention commanded by recent discussions in regard to the discrimination of wool, and the distinguishing of butter from oleomargarine which is not essentially a fraud and only becomes so when bought without a knowledge of its character. The sanitary and medical uses, in the investigation of water-supply, the purity and excellence of food and medicines, the accurate discrimination of diseases, the causes and laws of contagion (including that well urged but still disputed germ-theory of disease), are still more important themes, which, though comparatively familiar, still offer numerous vital points for completion or reconsideration. The usefulness of the lenses in war as well as peace, has been permanently established; the pigeon post of Paris during the seige having taught a lesson how the isolation of an invested city may be broken by their means.

The *legal* uses of the microscope, offer a department so large that it might almost be regarded as a new science under the name of Microscopical Jurisprudence; and a few suggestions in regard to that subject will occupy the remainder of this address. Some of its details, as for example the discrimination of blood and other important varieties of stains, have been treated, and conveniently, under medical jurisprudence, though they are not medical to any extent, and though they belong properly here. Others are entirely new and are appropriately, and, I understand, in the opinion of the courts, just as properly objects of judicial considerations as are the so-called medical portions.

The importance, in this respect, to humanity, of chemical, physiological, pathological, and microscopical learning and skill, can best be appreciated by reflecting upon the means which modern science and art have furnished for successfully violating the rights of fellow men, and for escaping from the consequences of such acts. With the telegraph, the popularized press, and the railway at command, it sometimes seems, notwithstanding the counter effect of these agencies in bringing criminals to justice, as if well-planned crime might be committed with impunity, and society lose so much of its safety as is derived from the fear of punishment. But at this point science appears with still more subtle means of discrimination, and the balance is yet preserved on the side of right.

The admission of the facts and opinions presented by scientific men as a proper means of influence in judicial procedures, or in other words, a general admission of expert evidence, having but recently become an important agency, and one that seems likely to grow in power if managed strictly in the interests of truth and science, it is essential that men of science, before falling into possible errors, should clearly establish and agree upon those principles of action which shall guide them in such cases. The spirit of science is that of truth, not partisanship. The facts and opinions of science should be developed with absolute impartiality. They should be given fully and freely, whether apparently favorable or unfavorable to the person for whom they are prepared.

The scientist should allow his name and influence to be used only when the full bearing of his statements, in spirit and in probable effect, and without qualification or reserve, is exactly what it purports and seems to be. Nor should he allow his aid to be used to the detriment, in his judgment, of honest individual or social interests. I am aware of the difficulty of this position; he cannot hope to judge correctly every case in advance, which even the members of the legal profession do not claim ability to do, but he should, in my opinion, limit his influence to those cases where the facts within his cognizance seem to fully, not partially, uphold his action, and where they do not seem likely to be used in the accomplishment of wrong. Fortunately he is under no compulsion of usage or the necessities of society to act in any case against his own convictions. The custom of defending, so far as practicable, almost every cause, however undesirable its success might be, although apparently unavoidable, is, in the judgment of those outside of the profession best qualified to decide, the least satisfactory point in the relations of present legal usages to the interests of society; a point at which no doubt all honorable members of the profession take the greatest care to prevent their personal success and that of their clients from becoming a hardship to others; where persons without character who are liable to creep into any profession without becoming assimilated to it, find it easiest, for selfish purposes, and with impunity, to make themselves the enemies instead of the friends and protectors of society. The scientific expert should be, in his limited sphere, as impartial as a judge; and he should appear in no cause where that policy would be unwelcome. It might be supposed that such a course, if deserving no credit, which it does not claim, would at least protect from detraction or insult; but it will not. It will be respected, I believe, by courts and by counsellors of respectability and influence, and it is to be hoped that some means may be found by which it can be protected also; but at present it must expect sometimes to sustain itself against disparagement and insult from some person who may have acquired the place without the character of a counsellor, who is none too honest to excite ignorant prejudice against notorious truth by the use of sneers and derision, none too generous to meet simple statements of facts with the merely brutal force of overbearing manners, none too brave to insult a person who is in his power, and none too well-bred to bring into the presence of gentlemen, of honorable counsellors, and of dignified judges, the methods, the manners and morals of a coarser civilization. If, as I have been assured by eminent members, the legal profession regards its incompatible and unworthy adherents with the aversion shown by other professions to theirs, it is not too much to hope that it may soon set a standard for itself which will practically command the obedience of all.

The examination of hand-writing, with a view to determine its authorship, its genuineness, its age, and whether or not it has been altered from its original form and intent, is one of the more recent uses of our microscope, and one the importance, reliability and frequent applicability of which has but recently become known, and is even now not generally realized. Perhaps this is to be accounted for by the fact that large general experience, judgment, and tact in the use of the instrument, and skill in the manipulation, though necessary to this particular work, are not, in themselves an adequate preparation for it. Much special study, and special practice, is required before anything useful can be done, or important should be attempted. But to a person really at home in the study of hand-writing, both with and without the microscope, this instrument furnishes a ready means for its accurate analysis. Those who are governed, not by respect for the rights of others, but only by the expectation of consequences that shall affect themselves, cannot learn too soon, or too well, the fact that writing can scarcely be changed, after its original execution, so adroitly that the microscope cannot detect the falsification. The face of the paper when once marred, by disturbing the position of the fibres, can never be restored; and hence scratching and erasure can be recognized though performed with consummate skill, and not distinguishable by other means. Inks which are alike to the unaided eye, are marked under the lenses by conspicuous differences of shade or color, or density, or purity, or chemical composition. Lines which look simple and honest, may show themselves as retouched, or altered, by the same or by different hand or pen or ink; and lines drawn upon new paper may look different from those after it is old. The microscope does not give any direct information as to the precise age of writing, but if used with sufficient caution it can determine (not so easy or safe a task as might be supposed) the relative age of superposed, crossing, or touching lines; and it can generally state positively whether lines were written before or after related erasures or scratchings, or foldings, or crumplings of the paper. In one important case, my friend, Mr. Wm. E. Hagan, of Troy, who has given extensive and very successful attention to the study of writing, especially imitative writing, and in association with whom many of my own investigations in this field during the last dozen years have been carried on, established the date of a document by recognizing in the paper, fibres which had only recently been used in paper-making, and which, in connection with corroborative proofs to which they led, demonstrated that the paper was manufactured at a later date than that claimed by the writing upon it.

To discuss the subject of imitative writing would require the opportunities of a book, and not of a fraction of a lecture; and many considerations of recognized importance connected with it are still under investigation, and not sufficiently mature for publication. A few hints may be given in respect to those points which are well established and most generally applicable. When a word, in a fictitous signature, for instance, has been constructed by tracing it with pencil lines over an original one, and subsequently inking it over with a pen, particles of plumbago can probably be somewhere detected and recognized by their position and their well known color and lustre. The mechanical effect of the point of a pencil upon and among the fibres of the paper can also be seen, notwithstanding the subsequent staining of the paper by the ink. This clumsy method of copying carries its own means of detection; and still it is not more easily recognized than are methods that are more subtle and seem more dangerous. In writing copied or imitated originally in ink, either by tracing it over a copy or by drawing it free-hand with a copy to inspect or to remember, the distribution of ink is peculiar and suggestive, indicating hesitation, from uncertainity, or pauses to look at a copy, or to recall a style or to decide as to a future course, just at points where a person writing automatically, by his own method, and especially in writing his own name or a scarcely less familiar business formula, would pass over the paper most rapidly and promptly. Again, there are certain ear-marks, results of habit, which finally become as natural as it is to breathe, and which characterize the writing of different individuals. Such are peculiar forms and styles of letters and of combinations of letters; methods of beginning or of ending lines, letters, words or sentences; methods and places of shading, or breaking lines, and of dotting, crossing, patching or correcting ; habits of correcting or not correcting certain errors or omissions; the use of flourishes; and peculiar ways of connecting words or of dissociating syllables. In imitative writing these ear-marks of another ownership are generally copied with ostentatious prominence, if not with real exaggeration, in the capital letters and other prominent parts, but lost sight of in those less conspicuous places where imitation naturally becomes feeble, and the habit of the writer unconsciously asserts itself ; and this revelation often becomes more positive by reason of the elaborate efforts that are made to suppress it. Things are overdone from fear, which would have been negligently done from habit; not to speak of gross blunders proceeding from the same source. I once examined a disputed signature from which had been carefully scratched out a line, immaterial and inconspicuous, which conformed to the habit of another person interested in the case, but not to the habit of the ostensible author of the writing.

Furthermore the genuineness of a writing may often be disproved by the very success with which it followed its copy; reproducing its mistakes, idiosyncracies, or its adaptions to its own special surroundings, in which respects it may correspond too accurately with some one genuine signature (in the hands, for instance, of a suspected person,) but differ unquestionably from the ordinary habit of the reputed author. Modifications of style by disease, as paralysis, may present similarly decisive discrepancies or coincidences. All these investigations in respect to writing can be best pursued with the aid of the microscope, and some of them are entirely dependent upon it. For general view of the words a four or three-inch objective is best adapted; for special study of the letters a 1¼ inch; and for minute investigation of the nature of the lines or character of the ink a 2-3ds or 4-10ths. The lenses, except the last, should be of the largest angles ordinarily made, and all should be of flat field and of the best possible definition. The microscope stand should have a large, flat stage; though it is generally preferable to use a small portable stand which can be moved freely over the paper and focussed upon it at any point without the use of a stage. For this purpose I sometimes use a tank microscope, but more frequently a pocket microscope with its tube prolonged through the stage by adaptors, so that it focusses directly upon the table. Even so large an instrument as Zentmayer's Histological may be so used to advantage, though a lighter form and smaller size is far more convenient and sufficiently steady for this work. Medium sized bull's-eye is sufficient for the purpose of illumination; and good judgment is more important than, if not incompatible with, the employment of an ostentatious and unneccessarily elaborate apparatus.

To illustrate the application of the microscope to the critical study of writing in cases of practical importance, and its dependence for much of its value on the appreciative comparison of related facts, I will describe a single and very simple case of altered writing occurring many years ago. A certain note, admitted to be genuine and properly signed, and upon which a considerable amount of money and a far greater value of character depended, bore date of the sixteenth of a certain month. The number of the year was printed on the blank except a single figure, 1, which was filled in with writing ink; there was also a figure 1 written below in the body of the note. The last named I was lightly and smoothly written, of such size, and color, and style, as might well have been written at the same time and by the same person as the rest of the note. But the figures 16 and 1 of the date were written clumsily, twice as large as the other, with a pen of different properties and with ink of different color and density. This peculiarity of these three digits was well explained by the claim, supported by the most plausible circumstantial evidence, that the date had been left blank at the time of drawing up the note, and had been filled in at the time at which it was subsequently signed, and with writing materials whose character sufficiently accounted for the nature of the figures. One person, who was largely interested in the note having been signed earlier than the date upon its face, and who well knew whether or not it was originally dated upon that day, asserted that its original date was several days earlier than that, though he did not fix it upon any one particular day. Another person who was admitted to have written the date, who had enjoyed unlimited opportunities for changing it if he desired, and was largely interested in its bearing a date not earlier than its ostensible one, asserted that that was its original and only date. At first sight, and still more after much patient study, it seemed hopeless to expect a solution of the case through the microscope or by any other means. The tracks of crime, if present, were never more carefully covered. The disputed figures were bold and strongly characterized. They showed no attempt to make them look like the rest of the writing, and therefore suffered nothing from failure to accomplish it; and their well marked character was satisfactorily accounted for. The surface of the paper was microscopically perfect, and had not been tampered with for purposes of erasure. Nowhere did a line crop out into view like those of the rest of the writing; and if any such existed beneath the visible figures it was doubtless pale and thin and little likely to be perceptible, even to the microscope, through the heavy coating of thick and muddy ink which covered and concealed it. At last, by one peculiar illumination, light being diffused rather faintly over the top of the paper and at the same time condensed strongly upon the lower surface, there came into view an appearance which was lost by the least change of illumination, but could be restored again by careful arrangement of the light. Blended with each of the three disputed figures, though not equally distinct in all, was a very peculiar wedge-shaped or triangular figure, broad and flat at the top and sharp at the bottom, and exactly such in size and position as would accord well with the rest of the writing and with the other figure 1 in the body of the note; but the latter one was broad and square at the bottom, and thus strikingly unlike the wedge-shaped 1's. Comparison of a large number of papers known to have been written by the same author showed that the unusually triangular 1 was his characteristic style, and that the unaltered and not triangular 1 in the note, known to be his writing, was not his usual habit but a rare and, as it proved in this case, a puzzling eccentricity. It was evident that the date had been first written 11, and that the 16 had been subsequently written over it; and that the 1 of the year, though the right figure, had been similarly enlarged to make it look like the rest. (Figures shown on blackboard.)

Still newer, but scarcely less important than this, is the study of powder marks, which call for investigation with the microscope less frequently, it is true, but are likely to be connected with results of the highest interest. Fixing the responsibility for a fatal crime, involving capital consequences, may turn critically upon such questions as the time of firing a certain shot, the position from which it was fired, the kind of powder used or the nature of the weapon employed, all of which questions under certain favorable but not improbable circumstances may be positively answered by our instrument. It is well known that modern gun powder is not a powder at all, but consists of hard and well-formed grains, often of considerable size, which by burning gradually and comparatively slowly from their surface only, gradually crowd the ball into increasing velocity as is moves through the barrel towards the mouth of the gun, and finally ejects it at a speed and with a power that would not be safely attained or even approached by a fine powder that would burn more rapidly and communicate its impulse more suddenly, and perhaps with destructive force to both ball and barrel. But before the grains are fully burned, the rapidly decreasing advantage gained in this way becomes more than counterbalanced by the resistance to the ball by continued contact with the barrel. Therefore the barrel is never made long enough for the powder to wholly burn before leaving it, and some of the burning grains must in all cases be thrown out as projectiles along with the ball. In using large charges and coarse powder some grains also may be thrown out that have not been ignited at all. The shorter the barrel, other things being equal, the more will this happen; as it will, also, in the case of the pistol, where the charge is generally less than in the rifle, but the flash is greater, because the barrel is shortened more than the charge is diminished. To observe the course of these burning grains to advantage, cause a pistol charged with coarse powder to be fired in the dark at a distance of a few metres, and at right angles to your line of vision, and the tiny projectiles will be seen to describe graceful curves each one mimicing within the range of two or three metres the trajectory of the leaden bullet in a course five hundred times as long. If the shot be fired through glass at a distance of one or two metres, the ball will pass through, leaving a hole that will vary somewhat in appearance according to circumstances, and the burning powder grains will leave, where they strike the glass, pale, greyish stains, which look somewhat like grease spots, or like the fungoid specks where diseased flies have adhered to the glass in autumn. They may be recognized, however, by their grouping around the bullet hole, by their microscopical appearance, and by chemical analysis, since they do not behave like grease in the presence of suitable tests; and Mr. Hagan has repeatedly obtained from them the sulphurous reaction of blackening a microscopic quantity of a salt of lead. Being caused by the burning powder grains, they indicate with certainty that the shot was fired near the surface; and a further hint as to the distance may sometimes be obtained from the degree of lateral or vertical displacement of the whole cluster as measured from the position of the ball-hole, the trajectory of the grains being considerably modified, and that of the ball not perceptibly so at such distances by gravity, or by a strong lateral wind. Still more interesting and suggestive are the appearances when the grains are fired against wood, paint, clothing, or the human face; the latter experiment being often tried by small boys who look into the touch-hole of a small cannon on the Fourth of July, to see whether the cannon is going off or not. and with the familar result of being so well satisfied of the fact that they can prove it any time thereafter. In such a case the burning grains may scorch and smut the surface, and the whole grains may bury themselves entirely below the surface, from beneath which they can readily be dug out, still in a condition capable of exploding. If the grains be small, or positive identification be required, by keeping the grain distinctly in view during the manipulation, it should be performed only under the microscope. How small a quantity can be thus treated may become an important question. Every intelligent person at all informed as to microscopical manipulation knows that an object of which it would require thousands to weigh a grain can with perfect ease and certainty be manipulated, examined, preserved and re-examined by any person of ordinary skill and ample experience in such work. To determine whether minute particles of powder could be not only seen and handled, but also burned with characteristic results, and finding it inconvenient to weigh such minute quantities, I procured one decigram (1-5 grain) of powder, carefully weighed, and found it to contain, by actual count, one hundred and fifty-three particles. Several of them, of average size, were selected, each of them being by estimate about the 1-100th of a grain in weight. One of these particles, tested by being placed on a strip of platinum foil, covered loosely with a cover-glass, and gradually heated over a spirit lamp till it burns, will explode with a distinct flash and an audible sound, both flash and sound being perceptible to several persons at once in distant parts of a small room. Similar results, though less in degree, were obtained from smaller quantities, estimated to be one-tenth as large, or 1-1000th grain. The experiment should be tried in a partially darkened room, but still so light that the black article can be distinctly seen and its identity assured until it explodes. A cloudy, greyish stain is left upon the under surface of the cover-glass, whose appearance is distinctly suggestive of the flash. As there is usually no difficulty in digging out grains as large as those I have mentioned, this test may be said to be applicable to cases where unaltered powder can be found imbedded. In this manner have been identified as powder, black particles taken from spots which had previously been characterized as pencil marks, and which, if powder, would absolutely prove a shot to have been fired from a position different from that which was understood to be implied in the theory of the prosecution. Examined under the microscope while still, and recently, imbedded in some dry substance, the powder grains appear to be dry and dark, and granular; and their ize may often be so fully determined as to ndicate positively to which of two different kinds of powder they belong. After being repeatedly or persistently moistened, they become brownish, and spongy in appearance, and may be surrounded by an eflorescence of nitre which is very characteristic. In some cases they become surrounded by a blueish ring on the white paint they have penetrated, believed to be produced by a reaction between the sulphur of the powder and the lead of the paint. Usually some of the grains only indent the film of paint, or the weather-hardened face of the wood, without imbedding themselves; and this may be true of all if the grains be small, the distance great, or the charge light. At a medium distance, the largest globular grains may imbed themselves fully, while the flat lenticular grains, if they strike upon their flat side, will only indent the wood, but if they strike edgewise will cut partially into the fibres if crossing their direction, but bury themselves deeply between them if they strike with a cutting edge in the direction of their length. In these various ways may suggestions be gained as to the kind of powder and weapon used, the weight of the charge, the distance fired, the time that has elapsed, and the treatment to which the surface may have been subjected by nature, by accident or by design. Further light may be obtained from the character of the hole made by the ball in passing through the glass; but this is independent of microscopical aid.

These hints concerning some of the fresher fields of microscopical study, show that it is timely as well as fascinating, practical as well as scientific. We pursue it at a favorable time. Never before was the microscope as serviceable an instrument as at present; never before were good microscopes so plenty and so cheap, or cheap microscopes half so good; never, perhaps, were more important fields for work fully open and recognized but yet unoccupied. We shall do poor work, indeed, if we do not make the microscope not only a source of pleasure to ourselves, but of more serious profit to science and to humanity.

AUG. 20.—MORNING SESSION.

The meeting was called to order by the President at 10.30 A.M., and found the Secretary, Dr. H. Jamison, of Indianapolis, at his desk. After the election of some more new members, a communication from E. H Griffith, of Fairport, N. Y., was read. Mr. Griffith said he would be glad to place in the hands of the President of the Society a silver medal to be engraved as he shall designate. This medal, the donor says, shall be awarded a first prize at the next regular meeting of the society to the member who shall present at that time the best two slides to illustrate the adulteration of some common article used for food, one of the slides is to show the pure article and the other a common adulteration of the same article. The adulterated article is to be procured of some dealer in groceries, and shall be such as is in common use. The adulteration and the percentage of such must be given. The persons who prepare the slides are not to be known to the Committee of Award until after the decision. All the slides for competition are to become the property of the society.

The letter was accepted as read by the Secretary, and a vote of thanks was tendered to Mr. Griffith for his offer.

Dr. Lucien Howe, of Buffalo, then read a paper on "The Development of the Eustachian Tube and Middle Ear," which was illustrated by enlarged drawings, and of which the following is a short abstract:

Dr. Howe believed that at a meeting of this kind no excuse was necessary for offering a thoroughly technical paper. No matter how deep one goes into the minutiæ of a subject, if it pertains to any branch of microscopy, it is of interest here. Not all of the members, however, are able to recall the details of the anatomy of the ear at a moments notice, and a few remarks explanatory are therefore appropriate. It will be remembered that this organ is divided into three principal portions, the external, the middle, and the internal ear. The first division extends from the outer appendage or auricle, to the drum head. The middle ear, or drum, a cavity containing the chain of small bones, which transmit the vibrations of sound from the drum head to the nerves situated in the third division, internal ear. The middle ear is connected with the throat by means of a canal called the Eustachian tube. It serves somewhat the same purpose as does the hole in the side of a drum, and is so often the seat of disease, that any details concerning it are of immense importance to the aurist. Facts which have no direct practical bearing thus become of interest if only as contributors to the common stock of scientific knowledge. He then proceeded to trace the formation of these portions from the earliest stage, illustrating each step by means of blackboard sketches and carefully prepared drawings. One of the latter was painfully true to Nature, and probably an excellent likeness of some gentleman or lady when actually about ten days old—but we must confess we were not particularly struck by the beauty of an individual at that age.

The opposing views of several German investigators and other authorities were quoted at length, the error of their statements demonstrated, and the real method of the growth of these parts shown.

Dr. Carl Seiler, of Philadelphia, then followed with an interesting and valuable paper on Photography which has been published *in extenso* in a previous issue.

This paper was discussed by Drs. Blackham, of Dunkirk, and Howe, of Buffalo, and Prof. Tuttle, of Columbus.

Prof. J. Edwards Smith, of Cleveland, then read a paper entitled "Remarks Concerning Modern Object-Glasses," which was very interesting and full of facts, demanding the closest attention of the members.

The subject of printing the proceedings in pamphlet form then came up for discussion, and called forth a rather lengthy debate, and the matter was finally referred to a committee.

The meeting then adjourned till afternoon.

AUG. 20.—AFTERNOON SESSION.

The meeting was called to order at 2 P M., and Dr. George E. Blackham opened the session by reading an extremely interesting paper on "The Systematic Examination of Objectives for the Microscope."

Then Mr. C. C. Merriman followed with a valuable paper on Double Staining, which has been published in full in a previous issue of this journal.

This paper called forth considerable discussion, as regards cements, and mounting materials, and the old strife about glycerine *versus* balsam for mounting, waxed hot for a while. Finally the advocates of balsam had the best of it; at least, they had the laughers on their side. Prof. J. Edwards Smith, Drs. Seiler, Blackham, Crane and Hyatt, took part in this discussion.

Prof. J. Edwards Smith then made some remarks on the way to construct a universal microscope, which he illustrated by exhibiting a stand made according to his directions, whose maker he, however, declined to name. This stand presented nothing new, but appeared to your correspondent, to be a compilation of the peculiar features of the instruments of different makers.

As no discussion followed, the meeting was, on motion, adjourned till next morning.

AUG. 21ST.—MORNING SESSION.

The meeting was called to order at about 11 o'clock, and after Prof. S. A. Lattimore, of Rochester, had been elected a member of the society, Dr. Deeke, of Utica, made some remarks on "The Microscopical Examination of Nervous Centres," which he illustrated by some exquisite sections of brain and medulla. He explained fully the section cutter, and the microscope, which he had devised for the preparation and examination of those wonderful sections, and also gave a detailed account of the manner of hardening a whole brain, which he preserved.

Prof. Kellicott then read the following paper which was illustrated with enlarged drawings.

ON CERTAIN CRUSTACEA, PARASITIC ON FISH FROM THE GREAT LAKES.

In this paper I propose to give an account of two species of parasitic crustacea from fish taken in Lake Erie, also of one from a tributary of Lake Huron. The first two are from the Toothed Herring, or Silver Bass, *Hyodon tergisus*, the third from the Rock Bass, *Ambloplites rupestris*. Of those belonging to the herring, one attaches itself to the gills, the other fastens to the outer surface of the body, or to the fins; the one from the rock bass adheres to the inner margin of the bronchial arches, or sometimes to the prominent teeth of the same. These forms, together with *Lerneocera cruciata*, make two species of these communistic leeches enjoying a home on each of these two well-known fishes.

The species referred to in this paper belong to the family *Lernæopodadæ* characterized by their manner of permanently fastening themselves to their host by means of a button or disc at the extremity of the united members of the last thoracic pair, and are thus separated, on the one hand, from the *Chondracanthadæ*, which hold on by means of their foot-jaws, which mode allows a change of place, and, on the other hand, from the Lernæoceridæ, which bury their head and upper thorax into the soft part of the host.

I content myself at this time with the presentation of description and drawings of these forms, together with such facts in their history as I may know; for I am not able to satisfy myself as to their identity until I secure material for which I am corresponding, and which when secured will, I expect, enable me to do so. Before proceeding with the sketches, allow me to express the hope that I may succeed to some degree in calling the attention of some of those who know how to use the microscope, to these creatures. The realization of such hope would certainly be reason enough and reward enough for preparing and presenting the paper.

No, 1. This form is explained by figures 1 to 4 on sheet I. It is found not uncommon among the gills and on the sides of the gill cavity of *Hyoden tergisus* taken in Buffalo harbor and vicinity during Autumn and Winter. It is rather a bulky species, inhabiting rather narrow quarters, but its parts are disposed accordingly. It is entirely without color except that in the sucker (Fig. 1, d), the fibre connecting it with the arms and the two rudimentary organs beneath the extremity of the body are brown, and apparently chitinous.

The outline of the body, seen from above, is broadly ovate, nearly as broad as long; seen from the side it is hemispherical, the tip being drawn well under (Fig 4). It thus reminds one of the abdomen of certain female spiders. The length of the head exceeds but little its breadth. The arms reach well above the head, and end in a strong corrugated fibre which attaches the suctorial disc. The disk is convex above, concave below, slightly ovate, emarginate. Above the arms stands a strong prehensile pair of limbs, the second foot-jaws; they are three-jointed, reaching to apex of head, the terminal piece obtusely rounded without hooks, carried at right angles to the second. (Fig, 1, j) The first pair of foot-jaws I have not been able to well define: they seem to be two fleshy organs lying parallel with the beak terminating in a small joint with two unequal teeth.

Looking down upon the apex of the head of a specimen treated with potassa a pair of apendages were defined which I take to be antennae; their appearance and position are designated in Fig. 2. I have been unable to make out any other appendages.

The ovigerous sacks (Fig. 3) diminish in size toward the apex; seen from the side they are shaped like a hay-knife; they are disposed over the body, but slightly exceeding it in length. There are as many as eight rows of eggs at the widest part, not more than four towards the apex. I estimate the number in each sack at one hundred; their diameter is .013 of an inch; at a certain stage of development each egg shows four brown points arranged in a quadrangle.

The full size of parts I measure as follows, a full sized individual being used:

Length of body and head	.28	in.
Greatest breadth of body	.13	"
Breadth of sucker	.12	"
Length of ovisacks	.13	"

No. 2. This second form, illustrated by figures 1 to 6 on sheet II, inhabits the same species as does No. 1. I have found it not uncommon during the greater part of the year on the herring taken by the fishermen along the Niagara River. It fastens to the surface, preferring the fins, although I have taken them from the under side of the body. They are more tenacious of life than No. 1 as they may live ten or twelve hours after being caught.

The dimensions of the parts of an average specimen were taken as follows:

Entire length from sucker to extremity of egg-tubes	.68	in.
Length of tubes	.24	"
Length of body and head	.31	"
Length of arms	.23	"
Greatest width of body	.1	"

The outline of the body is obovate, broadest at the beginning of the last third. Under the extremity of the body of an individual treated with caustic potassa may be seen two chitinous bodies. (Fig. 3, r) Originating near their extremity are the fibres which hold the egg-sacks, i. e. suspended from the lower border of the first, or lateral abdominal lobes; they are cylindrical, relatively long, straight and terminate in a straight, sharp spine, a fifth or more as long as they. At figure 6 is a drawing of an egg showing the well-advanced embryo.

The arms are long and slender, terminating with an ovoid button which adheres to the fish; the fibre connecting it to the arms is so short that it appears sessile. (Fig. 5, 6.) The second pair of jawfeet are robust, the terminal joint is carried at right angles to the second; its articulation with that joint is, however, very free; it terminates with one hook. (Figs. 2 and 5.) The remaining appendages which I have been able to define are shown in Fig. 4, which is, in part, a camera drawing of the underside of the apex of the head. I interpret the figure as follows: The first jawfeet at j; they consist of a robust basal part surmounted by two other pieces. One bears a short joint ending in a hook turned outwards, the other bears a disk, facing downwards, bearing numerous hairs also turned outwards. At a, is an antenna; the same may be seen less magnified in Fig. 5. I have seen a pair of styliform bodies at x, but not with sufficient distinctness to sketch them. No. 3. This third form is explained by the figures on the 3d sheet. It inhabits the inner surface of the gill arches of *Amblopliites rupestris.* It being a small species, and so mingled with the teeth on the surfaces they infest that I suspect it was overlooked many times, for after being acquainted with it I found one or more on fully one-half the examples of the fish examined. My acquaintance with it began in July of this year. Entire length from extremity of arms to end of ovigerous sacks a little more than .2 of an inch. Length of body and head a little above .1 inch. The outline of the body is broadly ovate, the upper part of the thorax terminating in the head similar in shape. The alimentary canal may be traced its entire length in living specimens, it shows brown granular matter within, especially in upper part. A contraction and dilatation passes rhythmically from end to end. At each pulse the canal is drawn first to one side and at the beginning of the next to the other side by fibrous bands shown at Fig. 1, r; these fibres arise from prominent protuberances. If these fibres are themselves the muscles that move the intestinal tube they are nonstriated, for I could bring the quarter-inch objective to bear upon them without seeing the striæ, while the inch clearly resolves striated muscles in the limbs and thorax. On either side of the lower body is an ill definable body (Fig. 1, 0) which I take to be an oviduct. On either side of the canal are numerous bodies which are doubtless eggs. I have counted sixty on one side, which certainly is more than enough to fill the egg sack once. These sacks are cylindrical, obtusely rounded at both ends, the length exceeding a little more than twice the width.

The arms are robust, long, ending in a button of the usual form; fibre longer than in No. 2. For the details of the underside of the head see Fig. 2, which was drawn by the aid of the camera, and shows all that was defined in their proper relations. I should designate the parts figured as follows: a, beginning of the arms; j, the second pair footjaws; i, first pair footjaws; a, antenna; i, styliform appendage, or second antenna; m, oral opening.

The male of this species I have seen, but owing to misfortune I was unable to sketch it, so I omit further reference to it.

At the conclusion of Prof. Kellicott's paper, the report of the Committee on Constitution and By-Laws was read and adopted, and a nominating committee of seven was appointed.

An invitation from Messrs. Lester Curtis and W. H. Bullock was received, in behalf of the Illinois State Microscopical Society, and the Chicago Academy of Sciences, to hold the next meeting in Chicago. An invitation was also received from Prof. Tuttle, on behalf of the Ohio Microscopical Society of Columbus, to hold the next meeting at that place.

These invitations were on motion referred to the Executive Committee.

Dr. J. Curtis, of Washington, then presented to the Society a box of earth rich in diatoms to which the members were invited to help themselves.

The meeting then adjourned till afternoon.

AUGUST 21.—AFTERNOON SESSION.

After calling the meeting to order, the President called upon Prof. Hyatt for a report of the Committee on Micrometry, to which Dr. Hyatt responded as follows:

BUFFALO, N. Y., Aug. 21, 1879.

To the American Society of Microscopists:

During the past year a committee upon the subject of Micrometry has been organized, representing a large number of the microscopical societies of the country, and consisting of the following members:

Prof. Wm. Ashburner, San Francisco, Cal.
President, F. A. P. Barnard, Columbia College, New York.
Lester Curtis, M.D., Chicago, Ill.
Geo. E. Fell, C. E., Buffalo, N. Y.
Henry Jamison, M. D., Indianapolis, Ind.
Prof. S. A. Lattimore, Rochester, N. Y.
Rev. Samuel Lockwood, Freehold, N. J.
Prof. Edward W. Morley, Hudson, O.
Joseph J. Richardson, M. D., Philadelphia, Pa.
Prof. S. P. Sharples, Boston, Mass.
Prof. Hamilton L. Smith, Geneva, N. Y.
Prof. A. H. Tuttle, Columbus, O.
C. M. Vorce, Esq., Cleveland, O.
R. H. Ward, M. D., Troy, N. Y.
J. J. Woodward, M. D., Washington.

This committee, as a result of individual consideration of the subject, and correspondence with microscopical societies and students, would respectfully and unanimously tender a report of progress to the American Society, and respectfully request this society to rescind its approval of the one-hundredth millimetre as a unit for micrometry, and to refer that question, together with those of securing precision and international uniformity, to the committee for further action.

After this report had been accepted, Mr. Thomas Taylor, of Washington, made some remarks on the parasites which infest and destroy agricultural plants, and passed around many beautiful drawings, illustrating his remarks.

Mr. C. M. Vorce, of Cleveland, then read a very able paper on, "The Destructive Power of Certain Insects," and was followed by Prof. Lattimore, of Rochester, with an essay on, "Microscopical Organisms Found in Drinking Water."

An invitation from the local committee to attend an excursion to Niagara Falls on Friday afternoon, was then read and accepted, and the meeting on motion adjourned.

MICROSCOPICAL SOIREE.

In the evening, a microscopical soiree took place at St. James Hall, which was a brilliant success in every way.

Over a hundred microscopes of different sizes, and shapes and construction were stationed in different parts of the auditorium and on the stage on tables, lighted up by students' lamps, and around them were gathered large and enthusiastic crowds of ladies and gentlemen, peering anxiously into the shining tubes at the many magnificent specimens displayed. The people all appeared to take the greatest interest in microscopy, plying the attendants at the instruments with innumerable questions about the objects shown, passing from one to another, and seemingly never tiring of this singular style of entertainment. Like martyrs, the microscopists bore the continued assaults of the visitors, and we doubt if Buffalonians ever encountered a more gentlemanly and willing set of men than those of last evening. All of the microscopists aimed at displaying their most attractive specimens, and those which the public would find the most interesting. Scientific names were dropped for the time being, and instead of *foraminifera*, *entomostraca*, etc., the microscopists came down to a level with the popular understanding and talked of their insects, shells, etc., in the plainest of Anglo-Saxon. For two hours and a half the inspection was continued, the throng remaining almost intact and busily moving about from stand to stand.

The microscopists pleasantly changed their specimens many times. In conversation with several of the prominent members, we learned that never before had they seen such beautiful specimens, many exhibibiting astonishing advancement in mounting and preparation, and the coloring in the insects and other natural specimens was said to be very life-like. The microscopes were among the best in the country, and several firms were represented by especially fine exhibitions. Below we give a brief description of what each microscopist exhibited:

The stage was occupied by three members. The largest display was that of Dr. Seiler, who is lecturer on Laryngoscopy, or diseases of the throat, in the University of Pennsylvania. He showed a section of the skin of the foot, the particular feature being a sweat-gland; the lip of a child, and a tubercle from the larynx of a child; also sections of the larynx, kidney, and the leg of a child from the toe to the knee. Dr. H. R. Hopkins, of Buffalo, gave a very attractive exhibition, in the fragments of a Brazilian pebble under the polariscope. The display of colors was unusually brilliant. Dr. H. L. Smith, of Geneva, had on his slide a specimen of *foraminifera*, a lagena from the Gulf of Mexico, it being an animal without any organization, just a mere mass. Nearly in the centre of the room was Mr. C. S. Shultz, the Secretary of the New York Microscopical Society. He had but one instrument, but his specimens were among the most interesting. He began with the diamond beetle of Brazil. The colors shown were very bright and beautiful. Later he showed the toe of a white mouse, a unique set of shells, and as a most astonishing piece of workmanship, he put under his instrument a slide on which was written with a diamond the Lord's Prayer, occupying about 1-32 of an inch, the letters being 1-1200 of an inch in diameter, and a second slide containing eighty small shells with their full name photographed in under each, all of which took up about 1-8 of an inch. One of the most practical exhibits was that of Dr. Lucien Howe, of Buffalo, including that of the muscle of the eye by which the focus is adjusted; a specimen showing how the blood was circulated, and the eye of a fly. He gave another exhibition detailing the manner in which blood is detected in criminal cases by the microspectroscope. C. E. Hanaman, of Troy, attracted much attention by his specimens of a section of the stomach of a cat, with the arteries filled with carmine, and sections of human hair, of the trachea of a child, and human kidney.

Dr. S. W. Wetmore, in the northwest corner of the hall, had several fine anatomical specimens, among the number being pieces of a healthy lung and kidney, and of a diseased lung and kidney; also crystals of sulphates of copper, morphine, etc. Mr. E. C. Fasoldt, of Albany, showed some of his own workmanship in the shape of rulings on the slides. Mr. George E. Fell, of Buffalo, had several instruments under his supervision, and he entertained his visitors with a sight of the itch insect, insect eggs on a leaf, and a number of other good specimens. Dr. W. Webster Butterfield was kept busy in the southwestern corner, explaining a Wenham prism of extraordinary dimensions, admitting more light than those of previous construction. He showed a number of fine specimens, a collection of phytotomical preparations, the work of Mrs. Julia Butterfield, of Indianapolis, being especially noteworthy. The latter were in two colors, and were prepared by a modification of the existent methods. Prof. J. Edwards Smith, who had been entertaining large numbers in a pleasant way, encountered for the time a serious loss. He had just set his instrument, when some over-zealous spectator in looking into the microscope, twisted off one of the important screws on the instrument, which rendered it useless for the time being. Mr. C. C. Merriman exemplified his plan of preparing and mounting vegetable tissue for microscopical observation by a section of the leaf stem of a castor-oil plant, calyx of the flower of pinguicula, etc., all of which were double-stainings. Some fine crystals of copper and of gold were displayed, the former by Dr. W. B. Rezner, of Cleveland, and the latter by Dr. G. E. Blackham, of Dunkirk. Prof. J. W. Ward, of Buffalo, had a pleasing exhibition of the circulation of the sap in vegetable cells, and Mr. W. H. Bulloch, of Chicago, showed a section of the moonseed. Prof. Herman Poole, of the Practical School, drew many visitors by his display of fat globules in milk and the head of a tapeworm. Dr. A. S. Wright, of Buffalo, had quite a marvel in the shape of a specimen showing the pores or canals in the bones, through which is transmitted the nutriment. Dr. F. P. Lewis gave a practical illustration of the cause of diseases in the ear by the exhibition of a fungus, which is the root of all such evils, taken from a human ear. Mr. DeWitt C. Green, of Buffalo, allowed all a good sight of those dreadful insects, the *trichina spiralis* of pork. Dr. Charles Carey showed the membrane of a cat's eye, and Prof. Kellicott had many admirers for his display of crystals of silver, gold, chromium, etc. Dr. T. S. Phillips, of Buffalo, had many fine specimens, such as young oysters, the tongue and the eye of a bee. Dr. W. C. West, of Monroe, Mich., had the papilla of a rat's tongue, the pollens of flowers, and butterfly scales, under his instrument at different times. Mr. C. M. Vorce went beyond many of his co-laborers by showing a monstrosity existing even among the lowest of animals. It was a specimen of the jaws of a leech, the owner of said jaws having sported two rows of teeth, one of which intersected the other, instead of one. He also had the eye of a lobster and a number of other specimens. Mr. G. S. Woolman, of New York, attracted many spectators by exhibiting an eye of a fly, crystals of gold, a mosquito, etc. In the back part of the room on a large table were a nice lot of microscopes from the houses of Bausch & Lomb, of Rochester, and J. W. Queen & Co., of Philadelphia. The interests of the latter were attended to by Mr. E. Pennock, who showed some rulings, together with specimens of the natural salt of quinine, as found in the Peruvian bark, and the seeds of the wild catch-fly. Mr. Bausch had a very interesting lot of specimens, the most noteworthy being a lot of butterfly scales arranged so as to form a cornucopia of flowers, some hippuric acid shown by polarized light, and a section of the ovary of calla lilly, a double staining. Mr. A. Landsberg, of Detroit, exhibited specimens of microscopical animals from Bermuda and Barbadoes Islands, also a section of a pear tree, sponge, and nerves of the head of a honey-bee. Mr. Henry Mills displayed the beauties of the well-known Julien slides. Dr. W. C. Barrett, of Buffalo, showed the tongue of a butterfly, sections of abnormal dental tissues; Dr. A. R. Davidson, of Buffalo, showed pathological preparations; Dr. Henry Jameson, crystals of gold, etc.; Clark C. Vanderventer, a variety of objects.

AUG. 22.—MORNING SESSION.

The closing session of the society began at 10 A.M., and was chiefly a business meeting. Reports of officers and committees were read and accepted, and the new officers were elected with the following result:

President—H. L. Smith, Geneva, N. Y.

Vice-Presidents—W. Webster Butterfield, Indianapolis; C. C. Merriman, Rochester.

Secretary—Albert H. Tuthill, Columbus.

Treasurer—George E. Fell, Buffalo, N. Y.

Executive Committee—Dr. W. Rezner, Cleveland; Dr. Carl Seiler, Philadelphia; Dr. W. C. Barrett, Buffalo.

Then followed resolutions of thanks, to the different individuals and corporations, for their aid in the success of the meeting. Finally, Dr. W. D. Rezner, of Cleveland, made a few remarks on "Illumination of Fine Rulings." In his mode of mounting he precipitated the lines so that the plating was on the same surface. He had no trouble in resolving Fasoldt's 120,000 band by sunlight with oblique light, with a Spencer sixth and an A eye-piece.

He was followed by Dr. Carl Seiler, of Philadelphia, who, by request of several of the members, gave a short account of his method of preparing and mounting animal tissues. He said that he always hardened the tissues in alcohol, commencing with a weak solution first and gradually increasing the strength of the hardening agent until the tissues were hard. The sections are made in a microtome, with a knife having a straight edge, after the piece of tissue has been inclosed in a mixture of paraffine and mutton tallow.

For staining he uses a carmine solution called Woodward's lilac fluid and then removes the excess of carmine by immersing the section in a mixture of 1 part of hydrochloric acid to 4 parts of alcohol. The section is then washed in alcohol, and is finally dehydrated in absolute alcohol, when it is ready for mounting.

If it is desired to stain with another color, the specimen, after having been washed, is left in a very weak solution of indigo carmine in alcohol from 6 to 24 hours.

For mounting he uses balsam dissolved in alcohol, as no previous clearing agent is needed, but if large or thin sections are to be mounted, he uses benzole to clear the section, and in it he floats the section on the cover, thus saving a great deal of time.

The rings around his specimens he said were made with damar dissolved in chloroform, and not in benzole.

In the afternoon most of the members participated in a most delightful excursion to Niagara Falls, where they remained till 9 P.M., viewing, after dark, the Falls illuminated by the electric light. Thus ended the second annual meeting of the American Society of Microscopists.

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On Stephenson's System of Homogeneous Immersion for Microscope Objectives.

BY PROF. E. ABBE, OF JENA, HON.F.R.M.S.

THE inventor of the Immersion method, Amici, with whose name so many important improvements in the Microscope are connected, attempted to use other fluids than water for the immersion medium. Amongst others he tried the highly refractive oil of aniseed, probably from the idea that the advantage obtained by replacing the stratum of air by a more refractive medium would increase with the increase in the refractive indices of the media employed. More recently others have used glycerine, and the well-known American optician, Spencer, has, according to report, produced objectives by this means of excellent quality.

The theoretical analysis of the immersion principle shows, that in several respects far more favorable results can be attained with a highly refracting substance than with water: it proves, however, at the same time, that the advantage to be expected is by no means proportional with the progressive increase in the refractive index; on the contrary, there is a maximum beyond which the results become less favorable. When the cover-glass and the front lens are of crown-glass, which is generally the case, this maximum is reached when the immersion fluid has the same refractive index as crown glass. A connection, which is optically homogeneous, is then established between the preparation and the objective, which eliminates all refraction in front of the first spherical surface of the optical system. Not only is the loss of light by reflection obviated, a loss which is experienced at every surface separating different optical media when the incident rays are oblique, but what is still more important, a very considerable amount of spherical aberration is at the same time prevented which otherwise would have to be corrected in the upper portion of the objective, but which must leave a residuum. Apart therefore from other advantages, such a method of "homogeneous immersion" gives promise at all events of a more perfect elimination of spherical aberration, and consequently more favorable conditions for what is called "definition" of the objective, than water immersion. It also possesses the further advantage, which is by no means inconsiderable, of getting rid of the disturbing influence of the cover-glass and doing away entirely with the otherwise indispensable correction. For where the intervening medium is equal in its refraction and dispersion to the cover-glass, it is immaterial, as regards the optical effect, whether a thicker layer of glass and a corresponding thinner layer of the fluid, or *vice versa*, is inserted between the object and the objective.

The idea of realizing the various advantages of such a kind of immersion, by constructing objectives on this system, had for some time presented itself to my mind, but I thought that there was not much to be expected, as regards the scientific usefulness of such objectives, as I believed their use would be limited on account of the necessity of using oil or some other inconvenient material as the immersion fluid. It appeared to me that, except perhaps for the examination of diatoms, scarcely any other scientific sphere remained than petrographic research, which would afford scope for realizing the optical advantages of such objectives.

The matter assumed, however, subsequently a different shape in consequence of a suggestion made by Mr. John Ware Stephenson (the Treasurer of the Royal Microscopical Society of London), who independently discovered the principle of Homogeneous Immersion,* but by whom, in addition to its other advantages, special attention was drawn to the doing away with the cover-glass correction, and to the possible enlargement of the angular aperture, with consequent increase in the resolving power of the objective. This idea of Mr. Stephenson, which made the matter one of universal scientific interest, was at once followed out, the calculations being made by me, and the technical execution by Mr. Zeiss, and resulted in the production of a series of objectives on this system which in several respects are manifestly superior to the ordinary water-immersion objectives. Having now been used by a number of microscopists, it has been found, that although the nature of the peculiar immersion fluid will naturally much restrict the employment of such objectives, it does not present any obstacle to their use in various widely different spheres of microscopic research; and in particular, biology furnishes many problems to which the new lenses may render useful service.

Since the construction, about a year ago, of the first objectives on this system, the focus being 1-8 inch nominal (more exactly 2·6 mm. equivalent focus), and all of them calculated for the long tubes of the English Microscopes, some have been made of 1-12 inch (1·8 mm.), which give sufficient magnifying power, even with the shorter tubes of the continental instruments; and quite recently a third series, 1-18 inch nominal (1·2 mm. focus) has been produced, by which, especially in histological observations, great amplification can be obtained with low eyepieces.

The angular aperture of all these objectives is about 114° in the immersion fluid for which they are adapted, the index of refraction being taken in round numbers as = 1·50.

This is approximately the same *angular* magnitude as can be attained without any great difficulty within the film of water in the usual immersion lenses, or within the stratum of air in dry objectives. But since the "numerical" equivalent of the angle of aperture (the measure which determines the number of rays taken in by the objective) is proportional not only to the sine of half the angle of aperture, but also to the refractive indices of the respective media employed, and since all the functions of the angle of aperture, and especially the resolving power of the microscope, are regulated by this numerical equivalent, it follows that, according to theory, the capacity of the new objective, compared with that of ordinary immersion lenses, is increased in the proportion of 1·50 to 1·33, and as compared with the highest dry objectives, as 1·50 to 1.

The product of the sine of half the angle of aperture into the refractive index of the medium—the "numerical aperture," as I call it—reaches 1·25 to 1·27 in these objectives. The ratio of these figures to unity expresses how much greater is the number of rays admitted by the new objectives, over that number which *in air* would fill a complete hemisphere, or which would be admitted by an imaginary dry objective of 180° aperture.

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* J. W. Stephenson "On a Large-angled Immersion Objective without Adjustment Collar," etc.—Trans. Royal Mic. Soc., i. (1878) 51.

This unusually large aperture is accompanied with a notable increase of resolving power. This is at once evident by the facility with which very fine striæ and similar markings become visible on the more difficult test objects; by the plainness with which the characteristic markings stand out on the more complicated forms, such as *Frustulia saxonica*, *Surirella gemma, etc.*; and lastly, by several unusual features which appear when certain methods of illumination are employed on the coarser tests of this kind, e.g. *P. angulatum.*

Histological preparations also furnish instances of very small elements closely clustered together, granulations and such like, in which clearer and more definite resolution is obtained in critical cases.

At the same time, in all these objects, especially in those last named, the decidedly more perfect definition which homogeneous immersion renders possible, is obtained, provided that the precision of the technical execution is adequate to the reduction effected in the residual aberration as indicated in theory. Therefore, when comparatively strong eye-pieces are used the image retains great sharpness, so that in regular work, higher amplification can be usefully employed than is usually the case with other objectives of equal focal length. They also often enable more exact observations to be made of very delicate objects, such as fine cilia, than good immersion objectives of the ordinary kind would permit.

Lastly, as a proof of excellence of definition which, though indirect, is of special weight, may be mentioned the favorable results which Dr. Koch, of Wollstein, obtained when examining bacteria,* viz. by employing a full cone of rays filling the entire aperture of the objective, a method of illumination quite unheard of as applied to such objects and with such an angular aperture. With this illumination, which can only be effected by the aid of a condenser of large aperture, the preparation is simultaneously penetrated in all directions by the incident rays. As a result, the delineation of such parts as stand out in mutual contrast through difference in refractive power (tissue structures, etc.), is almost completely suppressed, and there remain visible only those elements which act as absorbents through staining. On the other hand, the essential advantages of oblique illumination are retained, although the illumination remains central in name, in consequence of the co-operation of the rays incident at a large angle towards the axis of the microscope. Very small and closely clustered elements, as in preparations of bacteria, must certainly on both these accounts become capable of a more thorough resolution than with central illumination of the usual kind; if, however, this ingenious method of observation is to show corresponding results, the defining properties of the objective must stand a more severe test, and this test will be the more severe in proportion to the magnitude of the angular aperture employed.

As regards the nature of the immersion fluid, it is of course on optical grounds a matter of indifference what is selected, so long only as it is homogeneous and transparent, and equal or very nearly equal, to crown glass in refraction and dispersion. Experiment has taught, however, that this condition of homogeneous immersion leaves a much smaller choice than might be anticipated. At the outset I examined over one hundred fluids of the most varied kinds—essential and fatty oils and artificial chemical preparations—which I either tested myself or caused to be examined with the refractometer, to determine their refractive and dispersive indices, and lately the investigation has been carried still further by Dr. Töpel, who, under my guidance, determined the optical constants of nearly two hundred chemical combinations from the collection in the laboratory of the Jena University, which Professor Geuther was kind enough to place at our disposal. Among all of these, however, not one was found which, from its other properties, could be used; which either alone or mixed with other fluids attained the refractive index of crown glass (1·515 to 1·520 for sodium light) without at the same time more or less exceeding the dispersion of crown glass. A few only of the substances examined satisfied the necessary conditions with sufficient accuracy to permit the deviation to be regarded as unimportant.

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* 'Aetiologie der Wundinfektions-Krankheiten.' Leipsic, 1879.

The most suitable fluid that has at present been discovered, is cedar-wood oil (prepared by Schimmel & Co., Leipsic and New York) an essential oil almost without color or smell, and not volatile, but unfortunately rather thin. Its refractive index at a medium temperature is about 1·51, whilst the dispersion only slightly exceeds that of crown glass. The objectives have therefore been constructed for use with this oil.

For a more extended application of the principle of homogeneous immersion great advantage is derived from the fact, that by mixing one of the more highly refracting essential oils, such as oil of cloves, fennel, aniseed, or others, with a certain quantity of olive oil, fluids can be readily obtained which are equal to cedar-wood oil in refractive power, but whose dispersive power may be increased more or less, as required. This provides a means of regulating the chromatic correction of greater delicacy than is attainable by any mere mechanical correction, inasmuch as for cedar-wood oil can be substituted mixtures of various dispersive power, according to the nature of the object to be examined and the kind of illumination required. By this simple means, for example, the chromatic difference of spherical aberration, a correction-defect which (in the present state of practical optics) it is impossible to overcome in objectives of large aperture, is rendered for the most part immaterial. This unavoidable defect is apparent from the fact that the central and peripheral zones of the objective are never simultaneously perfectly achromatic. An objective which with oblique light gives an image as free from color as possible, is found, when central illumination is used, to be chromatically under-corrected to a marked degree, in the case of a sensitive object, and conversely. This is the more striking the larger the angular aperture. If, now, instead of a stratum (with parallel surfaces) placed in the course of the rays we substitute another of equal refractive but different dispersive power, we obtain a simple means of changing the chromatic correction of the objective without altering the spherical correction, and if, as is done throughout in the construction of these lenses, the chromatic compensation is so arranged that the fluid having the lowest dispersion (cedar-wood oil) produces the best achromatism for oblique light, the use of a more highly dispersive mixture of the kind mentioned will correct the chromatic defect for central illumination which would otherwise appear.

The application of this method is adversely affected by one circumstance only, viz., that the effect of a determinate increase in the dispersion, naturally depends upon the thickness of the fluid stratum. With covering glasses of different thicknesses, as also with objectives of different focal lengths, and corresponding different working distances, one and the same mixture will yield more or less unequal results.

Since the exact adjustment of the immersion fluid thus appears essentially necessary if the capacity of the new objectives is to be fully utilized, it is important to have a simple means of regulating the refractive and dispersive powers of the fluids in their relation to the corresponding factors in crown glass without having to employ special measuring apparatus. For this purpose Mr. Zeiss furnishes with each objective a small glass bottle with parallel sides, to the glass stopper of which is cemented a crown glass equilateral prism. This test bottle may be used in preparing the combined fluids, and by viewing the vertical bar of a window frame, etc., through both fluid and prism the difference between the fluid and crown glass, both with respect to refraction and dispersion, may be at once seen. The deflection of the image of the vertical bar in passing through the prism, and the width of the colored border, gives both these elements at a glance and with an exactness which is quite sufficient.

In the practical use of the new objective there are two further points to be specially noticed. The first is its dependence upon the length of the tube. The abolition of the cover-glass correction in these objectives, which is acknowledged by all observers to be an extraordinary advantage in manipulating the lenses with ease and certainty, nevertheless deprives the observer of a convenient means of compensating, within certain limits, the influence of different tube-lengths upon the aberrations.[*]

The objectives can therefore only be used with the length of tube for which they are originally adjusted, and they are so sensitive on this point (especially the lowest power) in consequence of the large angular aperture, that a deviation of a very few centimetres in the length of the tube produces visible changes in the condition of the correction. A draw-tube to the microscope affords therefore a very simple means of regulating according to the observer's own judgment, the ultimate more delicate adjustment of the correction, and also enables him—until some better immersion fluid is found—to compensate any small defect in the refraction of cedar-wood oil, which may be noticeable when very thick or very thin cover-glasses are used. (As lengthening the tube produces spherical over-correction, and shortening, under-correction, it follows that the former corrects a very thin covering glass, and the latter one of more than ordinary thickness.)

In using the objectives for photography, where the image must be at a considerable distance, unless an ordinary low eye-piece is used to photograph with, an auxiliary lens becomes requisite, which will remove the image to the required distance, without altering the course of the rays in the objective itself. For this purpose a concave lens of suitable focal length may be inserted close behind the objective in the same way as a short-sighted person uses concave spectacles to move the plane of distinct vision to a greater distance; a concave lens of relatively corresponding shorter focal length may also be interposed at a greater distance from the objective, in order to produce a moderate amplification (two or three times) of the image, and at the same time a decrease in the requisite distance of the plate. The position of the auxiliary lens in this case must of course be so regulated, by computation, that the cones of rays emerging from the objective converge towards the same plane as in ordinary observation.

A second point which must not be lost sight of in using these objectives—and in fact any objective the numerical aperture of which considerably exceeds the value 1—relates to the conditions which the illuminating apparatus must satisfy, in order that the whole angular aperture may be utilized with oblique illumination.

With a numerical aperture of 1·25 an incident ray, if it is to reach the external zone of the objective, must, when it impinges on the object, be incident towards the axis of the microscope at an angle of about 56°. Rays with this inclination cannot of course be transmitted to the objective out of air through a flat surface perpendicular to the axis, such as the lower surface of the glass slide. An incident ray reaching this surface from below would not, after entering the glass, be inclined towards the axis more than about 42°; and with the ordinary illuminating mirror even this obliquity could never be attained, apart from the great loss of light by reflection, which would greatly detract from the effect. In order therefore to utilize the maximum degree of oblique illumination, which an objective of such large aperture will admit—of course with objects which do not lie in air—and to bring out the full defining power of the objective, an illuminating apparatus is necessary, which not only gives a cone of rays of equal aperture with the objective, but which at the same time admits of a fluid connection with the under side of the slide. One immersion condenser amongst others which fulfils these conditions, is the illuminating apparatus described by me* some years ago, the system of lenses in which (corresponding with the angle of aperture of the older immersion objective, of Zeiss) possesses a "numerical aperture" of over 1·1 for its upper focus, and in the construction of which the connection of the front lens with the under surface of the slide by a drop of water, is taken into account.† In the absence however of an illuminating apparatus such as this, and where only very oblique illumination is required, a much more simple arrangement will be found very serviceable, which consists in connecting, by means of a drop of glycerine or oil, a plano-convex lens, nearly hemispherical, of 6–9 mm. radius, to the under surface of the slide, to which it will adhere. It may be kept sufficiently centered by means of a loose brass ring attached to it, having an external diameter equal to that of the stage aperture. The ordinary concave mirror, turned slightly outside the axis of the microscope, will then give cones of rays of any degree of obliquity which may be desired.

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[*] Dispensing with the correction-adjustment in the manufacture of such objectives is a matter of small moment in itself, when compared with the other technical requirements which are met by it. An essential benefit arises, however, from the simplification of the mechanical construction, in so far as it would scarcely be possible in a combination of lenses with *movable* parts to get the lenses centered as perfectly and durably as is possible in the case of a fixed combination; and in the present instance this appears an indispensible condition on account of the sensitiveness of the large aperture to the slightest defect in centering. Looking at this circumstance, it would be most unadvisable to provide such objectives with correction collars.

In conclusion, some account may be given of the optical combinations of the objectives for homogeneous immersion. Those constructed in Mr. Zeiss' manufactory, and based upon my computations, are all systems with four members. In this I have gone back to a type of construction which was applied by me experimentally many years ago, and has lately been used with considerable success by several opticians, especially Mr. Tolles and Mr. Spencer. Two single crown-glass lenses close together are made use of (duplex front) as the lower members of the system, and the two others only are compound, so-called achromatic (in the present case binary) lenses.

This form has certainly the disadvantage of leaving rather more chromatic difference of the magnifying power (that is, with perfect achromatism in the middle of the field of view there is more color towards the periphery) than is usually found when the front lens of the system is followed immediately by a compound lens of flint and crown glass; but this defect is practically inconsiderable in comparision with the facility with which it enables the angle of aperture to be increased. The form in which I have devised this type is nevertheless essentially different from the construction of which Mr. Tolles has published the elements in detail.* The difference becomes very apparent when the radii of the front lenses are compared with the equivalent focal distances of the respective objectives. The 1-6 inch of Tolles, described in the journal referred to, has almost exactly 4 mm. focal length, and its front lens a radius of 0·73 mm. In Zeiss's 1-12 inch, with 1·8 mm. of focal length—consequently less than half—the radius of the front lens is no less than 0·9 mm., and even with the 1-18 inch (1·2 mm. focal length) the smallest radius (0·6 mm.) is very little less than that of Tolles's 1-6 inch, whilst an objective of equal power would require, according to Tolles's formula, the abnormally small radius of 0·22 mm.

For the advantageous application of the duplex front in obtaining larger angular aperture, the more favorable ratio between the radius of the front lens and the focal length which is here attained will be of some importance, because it provides the only possible means of producing objectives of great magnifying power, without having too much recourse to the tube and eye-piece for amplification. By Tolles's construction it would be practically impossible to make an objective such as Zeiss's 1-12 inch, not to mention the 1-18 inch, with an angle of aperture of any considerable extent, to say nothing of the intolerable limitation of the working distance of lenses so abnormally small.

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* Max Schultze's 'Archiv f. Mikr. Anat.,' ix. 496.

† In consequence of the greater aperture of the objectives for homogeneous immersion. I have recently had a system of lenses constructed for an illuminating apparatus, the angular aperture of which reaches approximately the numerical equivalent 1·4. This will consquently give rays which are inclined 72° towards the axis in glass.

* Journal Royal Microscopical Society, i. (1878) 148.

As far as the mere observation of diatoms and similar test-objects is concerned, an objective of 4 mm., if thoroughly well made and possessing a good large angle of aperture, would indeed leave scarcely anything to be desired, especially as the small front lens of Tolles's construction involves relatively favorable conditions for the employment of deep eye-pieces. But when we take into consideration the much more complicated structures of the difficult objects of biological research, it cannot be doubted that systems which give considerably higher *objective* amplification will remain a real necessity until in practical optics more perfect methods of getting rid of the aberration than at present known are discovered. In my opinion, therefore, looking to general scientific requirements, the end to be kept in view at present is the production of objectives of sufficiently *short* focal length, which do not present too much difficulty in ordinary use, and this has been the principle which has guided me in my labors in this particular case.

A decidedly unfavorable feature in the formula which I have produced is the technical difficulty of construction, in which requirements are made such as were scarcely ever demanded and satisfied in the manufacture of microscopes. In this construction the spherical surface of the front lens must be utilized to an extreme extent, and must bear angles of incidence which for the marginal rays (on the air side) exceed 45°. The manufacturing optician has therefore to produce spherical surfaces of the small dimensions of the front lens, which shall be strictly true in form to the extent of a full hemisphere, and afterwards to mount these lenses in such a manner that without affecting the firmness of their setting they shall freely admit rays of light nearly up to the equator. The difficulty of this work and the extreme sensitiveness to the least defect of form and centering of the lenses, in a system of so great an angular aperture, make the production of such objectives an exceptionally troublesome and delicate task. All these difficulties of technical execution would, however, be considerably diminished if the increase in the angular aperture were to some extent sacrificed, and we were content with a numerical aperture of 1· to 1·1, which has hitherto been the ordinary aperture of immersion lenses.

I must for the present leave undecided the question whether the Stephenson immersion system might not prove of great practical service even under such restrictions. Of course such advantages would be surrendered as arise from the augumented resolving power, since this is essentially determined by the magnitude of the aperture. But there are surely objects enough in the domain of the microscopist, with respect to which a specially high resolving power is of less moment than the greatest possible perfection of definition; and the superiority of the homogeneous immersion system on this point, and the great advantage which the elimination of the disturbing effect of the cover-glass involves, would be diminished only to a very limited extent with a reduced angle of aperture. Assuming, therefore, that the nature of the immersion fluid admits the frequent use of such lenses, especially in biologcal researches, it might be desirable to try the system of homogeneous immersion in objectives of more simple construction, which would by their smaller cost be more generally used.

In the other direction, however, the extent to which the new immersion method will lead us has been by no means exhausted by the new objectives.

From the result of the first step it cannot be doubted that by this system considerably larger apertures of moderately short focal length are still attainable, notwithstanding the increasing difficulties of computation and construction. It being unquestionably a matter of interest to extend the resolving power of the instrument to its extreme limits by any means in our power, even if the unavoidable refinements in such objectives scarcely admit of their frequent application, the attempt has been undertaken in the optical manufactory here. I hope soon to be able to show objectives of 4–3 millimetres focal length, the numerical aperture of which is increased to 1·35, corresponding to an aperture angle of 128° in a medium with an index of 1·50. This figure, however, would be the extreme limit which can at present be attained, unless cover-glasses of flint glass are used for the object, and at the same time an immersion fluid of corresponding refractive index is applied.—*Jour. Royal Mic. Soc.*

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Contribution to the Germ Theory.

DR. ROBERT KOCH has published an important monograph on the ætiology of infectious traumatic diseases.* The paper opens with a definition of the diseases treated of, and a review of the present state of our knowledge with regard to *contagium vivum*, and of the arguments for and against the doctrine. Then follows a description of the author's method of research, and then the most important part of the work, a detailed description of his exact and laborious experiments on artificial traumatic diseases.

1. *Septicœmia in Mice.*—Putrid blood or infusion of meat was injected under the skin of the back. Characteristic symptoms showed themselves, and the animals died in four to eight hours. No bacteria were found beyond those injected, so that in this case the disease was evidently due to a soluble poison, (sepsin), and not to the agency of microphytes. In correspondence with this no effect was produced by very small injections (1 to 2 drops) except in about one-third of the cases. In these, different but equally characteristic symptoms supervened, death took place in about fifty hours, and a post mortem examination showed the blood to be crowded with small bacilli about 1 μ in length, which occurred in the vessels of all organs of the body, surrounding the red corpuscles and absolutely filling the white. Even 1-10 drop of the blood thus affected was able to communicate the disease to another mouse, and the disease was, in fact, carried through seventeen generations. There seems little doubt that the bacilli are the actual contagium of this form of traumatic septicæmia. It is a curious circumstance that field-mice and rabbits were not susceptible to the disease.

2. *Progressive Tissue-necrosis* (*Gangrene*) *in Mice.*—In mice injected with decomposing blood there were sometimes found at the place of injection (in the subcutaneous tissue) micrococci, as well as the regular bacilli of septicæmia. These micrococci had a diameter of 0·5 μ, multiplied rapidly, and showed a great tendency to the formation of "chains." Lymph from the subcutaneous tissue infested with these was injected into a mouse's ear. The micrococcus-chains soon multiplied so fast as to interpenetrate the whole ear, the tissue of which became so changed as to be hardly recognizable; cartilage cells looked pale, as if treated with potash, and blood and connective-tissue corpuscles were no longer to be seen. It seems clear that the septicæmia-bacillus is a necessary forerunner of the gangrene-micrococcus. An interesting pure-culture experiment was tried. Field-mice, which, as stated above, are not susceptible to septicæmia, were injected with fluid containing both bacilli and micrococci. The former had no effect, the latter multiplied and caused death, and from the animals so affected both field and house mice could now be inoculated, the result being always gangrene and never septicæmia.

3. *Progressive Abscess-formation in Rabbits.*—Rabbits were injected with putrid

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* 'Untersuchungen uber die Aetiologie der Wundinfectionskrankheiten," Leipzig, 1878.

blood. A flat, hard, lenticular infiltration was gradually formed at the place of injection, producing at last a fatal abscess in the subcutaneous tissue. The abscess was covered by a thin layer of micrococcus-zoogloea; its cheesy contents were finely granular, and contained no bacteria, but were probably derived from the zoogloea and from the enclosed dead tissues. The individual micrococci were 0·15 μ in diameter. The blood of rabbits dying from this disease produced no infection, but the disease was communicated by injecting a little of the interior of the abscess rubbed up in water.

4. *Pyæmia in Rabbits.*—A rabbit was injected with fluid obtained by macerating mouse-skin in water. A purulent infiltration of the subcutaneous tissue resulted, accompanied by swelling of the spleen, morbid changes in lungs and liver, and peritonitis. Micrococci abounded in the affected places, occurring in the blood-vessels surrounding the corpuscles, and forming accumulations which sometimes quite obstructed the lumen. These micrococci are distinguished from those of gangrene and abscesses by not forming chains or zoogloea, and by their size (0·25 μ). For inoculation, 1-10 of a drop was sufficient, but not 1-1000.

5. *Septicæmia in Rabbits.*—The animals were injected with a putrid infusion of meat. A purulent accumulation (jauchige Vereiterung) took place, and the subcutaneous tissue in the neighborhood became filled with a watery fluid, containing large oval micrococci (diameter 0·8 to 1 μ), which also occurred in the kidney and spleen. Injection of 5 to 10 drops of the œdema fluid communicated the fatal symptoms.

6.—*Erysipelatous Process in Rabbits.*—The ear was injected with mouse's dung, softened in distilled water. The organ became red, swollen, and flabby, and was found to contain large numbers of bacilli 3 μ in length and 0·3 μ in diameter. The author failed to communicate the disease to other animals.

After the description of these experiments, Koch devotes a few pages to splenic fever, and then sums up his results, and discusses their importance. For the first five cases there is complete, for the sixth partial evidence of parasitic nature. Infection is produced by so small a quantity of fluid, that toxic effects are quite excluded. For each disease the bacterium-form is distinct and unchangeable; this is the most important result of all. The living body is the best possible pure-culture apparatus.

Some former writers have stated that the virulence of the poison in these diseases increases constantly in successive generations; Koch considers that it increases up to the second, or latest the third generation, and then remains constant.—*Jour. Royal Mic. Soc.*

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Employment of Wet Collodion for Microscopic Sections.

M. Mathias Duval points out* the difficulty of finding any body which would firmly hold delicate objects, in which there are a large amount of hollows and cavities, such, for example, as embryonic tissues; it is obvious that the best substance would be one, which though solid is not friable, and which at the same time is homogeneous; these conditions are not satisfied by the ordinary imbedding mixtures, such as gelatine, wax and oil, or soapy bodies; one that has been largely used is gum solidified by the action of alcohol, and this has been recommended by Dr. Klein; in the directions appended to their "Treatise on Embryology" (of the Chick), Foster and Balfour expressly state that they do not recommend it for the study with which they are there particularly engaged, nor does the experience of other embryologists seem to do otherwise than confirm their opinion. Nor, again, do the methods ordinarily in use allow of the advantages which would be gained by the use of a transparent imbedding substance.

Already used in its *dry* state for certain observations, collodion has been found to have much to recommend it, but it is too hard for delicate bodies; when, however, a small quantity is treated with alcohol at 36°, it is found to retain its volume, while presenting a large amount of consistency, elasticity, or transparency. Having used the substance for six months, M. Duval now feels justified in recommending it to the attention of students; the embryos to be examined are first hardened by osmic acid, alcohol, or some other method, are stained with carmine, and then placed in alcohol; they are placed for a few minutes in ether, and are then removed to the liquid collodion, in which they remain for a period varying from ten minutes to twenty-four hours. When withdrawn from this, they have attached to them a piece of elder-pith, or are, if their size and state permit of their being cut without any such aid, thrown at once into alcohol; the body now becomes surrounded with an elastic mass of collodion, which solidifies without alteration of volume, and encloses the pith if this has been already added. Thus treated, the tissue is ready for immediate section, or may be kept in alcohol for an indefinite period without danger.

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* "Journ. Anat. et Phys." (Robin), xv. (1879) 183.

As the sections are made in the ordinary way, that is, the body itself and the razor being both wetted with alcohol, it is obvious that the collodion will be prevented from becoming dry; there is no need to remove the imbedding substance, and the section may be immediately placed on a slide; a drop of glycerine and a cover-glass are then all that is necessary for the observer to find himself delighted with an object, the optical properties of whose imbedding substance are exactly the same as those of glass. Another advantage remains to be noted, the collodion has not in M. Duval's sections lost its transparency after a period of six months.

A similar method may be used for fœtal cerebral structures, and in the study of the eye or of the cochlea and similar delicate parts.—*Jour. Royal Mic. Soc.*

Method of Preserving the more Delicate and Perishable Animal Tissues.

In a valuable article * on the development of the earth worm, *Lumbricus trapezoides* Dugès, M. Kleinenberg says that whilst a great part of the earliest formations of the egg can be made out in the living state, the protoplasm being sufficiently transparent to allow the internal parts to be seen, yet afterwards the precise outlines of the cells disappear, and nothing can be seen but the grosser structure. To make out the more delicate structure it is necessary to employ reagents.

Osmic acid applied in the state of vapor gives good results; but the preparations obtained by the use of a mixture of picric with sulphuric acid are more satisfactory. It has, however, the same drawback as osmic acid, of occasionally producing swellings in the primitive blastomeres, which, if it only slightly alters the normal conditions, renders the preparations less sightly. This difficulty is overcome by the addition of a little kreosote.

M. Kleinenberg, however, after many experiments, recommends strongly the following method of preservation, which he used for the particular researches treated of, and for the majority of other animal tissues, especially for the more delicate and perishable.

Prepare a saturated solution of picric acid in distilled water, and to a hundred volumes of this add two volumes of concentrated sulphuric acid; all the picric acid which is precipitated must be removed by filtration. One volume of the liquid obtained in this manner is to be diluted with three volumes of water, and, finally, as much pure kreosote must be added as will mix.

The object to be preserved should remain in this liquid for three, four, or more hours: then transferred, in order to harden it and remove the acid, into 70 per cent. alcohol, where it is to remain five or six hours. From this it is to be removed into 90 per cent. alcohol, which is to be changed until the yellow tint has either disappeared or greatly diminished. Alcohol of 90 per cent. is better than absolute for preserving the more delicate structures for a long time uninjured, and for keeping the preparation at the proper degree of hardness.

For coloring, crystallized hæmatoxylin is to be used, dissolved in the following mixture:—Prepare a saturated solution of calcium chloride in 70 per cent. alcohol, with the addition of a little alum: after having filtered, mix a volume of this with from six to eight volumes of 70 per cent. alcohol. At the time of using the liquid pour into it as many drops of a concentrated solution of hæmatoxylin in absolute alcohol as are sufficient to give the required color to the preparation of greater or less intensity, according to desire.

This mixture, notwithstanding its chemical irrationality, gives good results. Aqueous solutions, especially when they contain traces of ammonia, are to be avoided, since they are very hurtful to many delicate tissues. The object must remain in the dye for a period varying from a few minutes to six hours, according to its size and to the nature of the tissues composing it. It is a good rule, when intending to make sections, to stain deeply and to cut them *very thin.*

When removed from the dye the preparation is to be washed in 90 per cent. alcohol, in which it may remain from six to twelve hours. Finally, to remove every trace of water, it should remain for half or a whole day in absolute alcohol.

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* "Quart. Journ. Mic. Sci." xix. (1879.) 206.

If the preparation is to be cut it must be removed from absolute alcohol to essential oil of bergamot, in which it should remain for some hours, in order to fit it for being imbedded in paraffin, which is removed from the sections when cut by means of a mixture of four parts of essence of turpentine with one part of kreosote. Finally, the sections are mounted in resin dissolved in essence of turpentine.

Histologists are warned not to use a solution of resin in alcohol. The preparations mounted in this are at first beautiful but soon become spoiled, in consequence of the precipitation of crystals or of an amorphous substance. He lost in this manner many hundreds of preparations, and the same results have occurred in the Zoological Station at Naples.—*Jour. Royal Mic. Soc.*

Cochineal for Staining.

Dr. Paul Mayer,* of the Zoological Station at Naples, when making experiments to find an alcoholic carmine solution with which to stain satisfactorily entire chitinous membrane, tried the tincture of cochineal, which not only answered the desired purpose, but showed itself suitable for general application wherever it is required to stain by an alcoholic method animal tissues preserved in alcohol, and to keep the preparation thus obtained in a resinous medium.

The pulverized cochineal is left for several days in contact with 70 per cent. alcohol, 8-10 c. cm. to a gramme, and the dark red liquid filtered. *The object to be stained must be free from acid*, and it is best to lay it for some time previously in fresh alcohol of 70 per cent. According to the intensity required and the nature of the object, the staining takes from a few minutes (infusoria, marine larvæ, etc.) to a few days (the higher crustacea, large annelida, young cephalopoda, organs of vertebrata, etc.)—The subsequent removal of the staining material which is not fixed in the tissue, is effected with 70 per cent. alcohol, and takes days in some cases; it can never, however, be continued too long, and should not be stopped until the alcohol takes no more up.

By this method, assuming that the object has been properly preserved, a very precise and nearly always intense nucleus stain is obtained, and in by far the majority of cases this is not, as might be expected, colored red, but hæmatoxylin. Dr. Mayer expects to be able to give the explanation hereafter of this strange phenomenon, which, however, is no detriment to the process. In consequence of the precision and tint of the stain, the preparations are for the most part not to be distinguished from those obtained with hæmatoxylin. The cochineal tincture also possesses, in common with the well known alcoholic hæmatoxylin solution of Kleinenberg, the property of not altering the tissues; on the other hand, it compares favorably with it in the simplicity of its production and application, as also in the hold taken by the stain, which in this respect is equal to carmine. On the other hand, there is the defect that hitherto the attempt to stain large objects sufficiently deeply has not always succeeded; although the spinal marrow of the calf, in pieces one centimetre long and more, could be stained uniformly and deeply enough.

With a little care, permanent overstaining need not be feared, and can be removed by washing in acid alcohol (a drop of muriatic acid to about 10 c. cm. of 70 per cent. alcohol).—*Journ. Royal Mic. Soc.*

Picro-Carmine for Cell-nuclei.

In the report published last August of the Proceedings of the International Congress of Botanists, held at Amsterdam, in 1877, is a paper by M. Treub, who drew attention to the use of picro-carmine as a reagent for this purpose. His first step is to kill the cells by absolute alcohol, according to the directions of Strasburger. After making some sections of tissues which had remained in the liquid, the preparations are placed in a 1 per cent. solution of picro-carmine, for a time varying from four to twenty hours; they are then shaken in distilled water in order to dissolve the picric acid, and are placed in a mixture of glycerine and distilled water, which is gradually replaced by pure glycerine, containing 1 per cent. of formic acid. After this treatment the nuclei almost always assume a fine red color, whilst the protoplasm remains entirely uncolored, which enables the slightest changes which take place in the nuclei to be at once distinguished.*

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* "Zoologischer Anzeiger," vol. i. p. 345.

* "Bull. Soc. Bot. de France," vol. xxv. (1878) p. 129.

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Erratum.

DR. WILLIS calls our attention to the fact, that in his article, published in our previous issue, page 155, line 12 from top of second column, the word "tube," should be "table."

Prof. J. Edwards Smith's Work on the Microscope.

IT will give our readers pleasure to know that this book is in press, and will probably be ready some time in March. It has been carefully revised, and brought down to the very latest point of microscopical progress, and as a work for teaching the best methods of handling the microscope, it will, undoubtedly be the best in market.

There is at present no work in the English language which gives instruction in the best methods of handling the most modern microscopes and objectives. Prof. Smith's work will, therefore, fill a long felt hiatus in our microscopical literature. We shall duly announce it when ready.

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The Address of the President of the American Society of Microscopists.

WE give in this issue a very full report of the proceedings of the American Society of Microscopists, at the meeting held at Buffalo, last August. Amongst other things, we give the President's Address in full. This will be found an exceedingly interesting and instructive document, well deserving careful perusal by our readers. There are, however, some points to which serious exception might be taken. Amongst these are the history of recent changes in our postal laws, and the recent discussions in regard to micrometric units and standards. Dr. Ward has evidently obtained his information in regard to the latter subject, from interested and one-sided reports, or he never would have waxed so warm and earnest in advocating that which nobody opposes, or, in denying that which those who are familiar with the facts in the case, know to be true.

No one, that we know of, opposes the

general introduction of the metric system amongst microscopists. Some persons, ourselves amongst the rest, have opposed the passage of any resolution looking to the exclusion of papers or work of any kind in which the inch is used as a unit. It may surprise some of our readers to hear that any person could be found who would be so foolish and crotchetty as to offer such resolutions, but they were actually offered at a meeting of the New York Microscopical Society. They were, of course, modified when the writer of this called the attention of the members to the inevitable results which would follow, and resolutions simply *recommending* the use of the metric system, were then offered and carried unanimously, the writer, amongst others, voting for them.

Those who are so very earnest for the adoption of the metric system in all micrometers, seem to forget that the most common purpose to which a micrometer is applied is the measurement of the magnifying power of the microscope, and that for this purpose it is utterly immaterial what system is used. It is even probable that the best possible system for this purpose, that is obtainable by any private worker, will be found to be one which has no reference at all either to the inch or the metre, but may be measured by either at any subsequent time.

Experienced microscopists, no doubt, understand this, but, for the sake of our many readers who take an interest in this subject, and who have not had an opportunity of studying it thoroughly, we will explain what we mean.

In drawings of minute objects, made by means of the microscope, it is usual to state the magnifying power used, and by means of the draw-tube it is easy to bring this magnifying power to an even number, such as 100, 200, 250, etc. If, then we ascertain accurately the magnifying power of a microscope, and bring it say to 100, all that we have to do in order to measure the size of any object that has been delineated, is to measure it with a common rule and divide the measure by 100. Thus, if we find that a diatom, as drawn under a power of 100 diameters, measures exactly one inch, then the real measure is, of course, just 1-100th of an inch. If it should be a decimetre, the real size is a millimetre, In this case, the point that requires greatest care, is that the relation of the micro measure to the macro-measure, (the micrometer to the macrometer,) shall be accurately known. Their relation to any existing system is a matter of no consequence whatever.

From this it will be seen that the micrometer is but half the battle. The large measure—inch or centimetre—is equally necessary, and as foot rules are to be found in every hardware store, while (for the present at least) centimetres are rather scarce, it is best for those who wish to get along as easily and cheaply as possible, to provide themselves with micrometers graduated to parts of an inch.

Indeed, of so little consequence is the system that may be adopted, that we might suppose every microscopist to have a system of his own, without introducing any confusion whatever. Let us suppose that a microscopist has a measure which we will call, for convenience, a *hand's breadth,* (and there may be as many different standard hand breadths as the microscopists of the world have hands) and that this hand's breadth is accurately divided into a hundred equal parts. Let us suppose that he has also, a stage micrometer in which the hundredth of a hand breath is divided into one hundred equal parts. If his microscope magnifies the divisions on his stage micrometer so that each one covers exactly five of the divisions of the hand breadth, then all objects examined under such a power will be magnified five hundred diameters, and if drawings be made under this power, the objects delineated may be accurately measured by a rule divided either into inches or into centimetres. So that the microscopist whose micrometer is divided into parts of an inch, can give *actual* measurements (not *calculated* measurements,) in millimetres with as great accuracy, as if his micrometer was divided into millimetres, the only thing that is necessary being a metric rule, and this is easily obtained.

All this is familiar knowledge to practical workers with micrometers, but is not generally understood by beginners; hence we find that while experienced microscopists trouble themselves very little about *this* part of the subject, those who have not given much attention to the matter, regard it as all-important.

Dr. Ward seems to dwell with some regret, upon the fact that the defects in the Indianapolis resolutions, in regard to micrometry, attracted more attention than their good points. This is undoubtedly true, but it is not to be wondered at, seeing that they were open to the old Johnsonian objections: "They contained much that was new, and much that was good, but, unfortunately, what was good was not new, and what was new was not good." As a natural consequence of this, they have been repudiated wherever they have been intelligently discussed, and this by the highest authorities, such as the Royal Microscopical Society of England, many of whose members are strong advocates of the metric system as embodied in the C. G. S. system of Units.

It is to be regretted that Dr. Ward should have allowed himself to apply the following expressions to the opponents of the Indianapolis resolutions:

> The liberal offer of Professor Rogers was wholly misunderstood and perverted, until it took the form of the preposterous statement that it was proposed to make Prof. Rogers' micrometers standard as distinguished from those of other (!) makers, not the least amusing of all the blunders and absurdities of this precious statement being the association in any manner, of trade rivalry or mercenary considerations with the work of one of our most generous scientists.

The persons to whom this is here applied, have a tolerable familiarity with the English language, so that they feel pretty certain that unless words convey no meaning the statement did not originate with them, but with certain parties who have undertaken to advocate Mr. Rogers' cause. There has been shown no desire to detract from the credit due to Mr. Rogers for the work which he has done, and all the opposition which has been called out, has merely been to certain extravagant propositions which we feel very sure that Mr. Rogers himself would repudiate. In this matter he may well repeat the prayer of the old Spanish knight: "O Lord, save me from my friends, and I will take care of my enemies myself."

In the opening of Dr. Ward's address, occurs the following passage: "It is within the memory of persons now only in middle age, that * * * the high price of English instruments was repeatedly and formally stated, as the reason of their limited sale in this country, where they are now commended by their cheapness as compared with those manufactured here." One would have supposed that it would have been a matter of pride to a native of this country, to have been able to state a fact which is familiar knowledge to those who are acquainted with the subject, viz., that the cheapest, as well as the best instruments in the world, are manufactured in the United States.

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Our Expert System.

THE system at present in vogue in our courts for procuring testimony in regard to scientific facts, is a disgrace to our jurisprudence and to our science. Under our present system, two sets of experts are generally employed, and they, as well as the plaintiff and defendant, are placed on trial, being badgered, browbeaten and worried by lawyers who endeavor to make up for scientific knowledge and a good cause by an unlimited amount of impudence and abuse. It is not to be wondered at, therefore, that they take sides in the case, and instead of endeavoring to find out the truth and promote the cause of justice, they simply seek to secure the success of the side which has employed them, and which is to pay them. We speak now of reputable scientific men, called upon by one side or the other to support the "theory" of the prosecution, or the defence. We do not refer to those professional experts, who make a trade of appearing as witnesses, and who leave no means unemployed by which they can influence the minds of the jury, and so secure a verdict for their side. They even go so far as to bring into the court room imposing and dazzling sets of apparatus,' by which they hope to impress upon the mind of the ignorant juryman, a sense of their great skill and proficiency—the presumed inference being that a man that can use such apparatus as that, must know what he is talking about.

Truly scientific men are above such clap trap, and might in general be trusted if it were not for the fact that in the court room they are pitted against each other, like gladiators in the arena of a circus. Under such circumstances, it is beyond the power of the most evenly balanced mind to preserve that nice sense by which it weighs the value of the facts brought out in any series of investigations, and hence we find the most contradictory statements made, not alone in regard to doubtful questions, but concerning well established truths. .

We suppose that so long as our present jury system continues in existence, this defect in our jurisprudence will remain. It has often occurred to us, however, that much of the opprobrium which now attaches to our expert system, would be removed if, instead of two sets of experts, there were only one, consisting of a board composed of men of recognized ability under whose direction all investigations and analyses should be made, and who should be bound, so far as they could, to give true answers, *in writing*, to any questions propounded by either side. Let the prosecution propound their questions and obtain their answers; these answers should be submitted to the defence, who in return, would be at liberty to propound a contrary series of questions; the questions and answers of the defence being submitted to the prosecution, would give rise to another set of questions and answers, and the defence should have a final opportunity of bringing out any points that they might deem of importance. The questions being submitted in writing, and abundant time being given for the answers, none of this catching and browbeating could occur, that now so frequently turns the scale unjustly, for one side or the other. The experts, seeing their answers before they went on record, would be careful not to commit themselves to doubtful or erroneous statements.

It must be borne in mind, that the answers given by an expert are of a kind totally different from those given by a person who testifies merely in regard to certain facts of which he is cognizant. A man does not require long to think whether or not he performed a certain act, but it sometimes takes him considerable time to recall the scientific truths which bear upon the question at issue. Expert testimony is anomalous, under any view we may take of it, and we may as well go a step farther, and not only separate it entirely from the testimony of witnesses who testify as to simple facts, but treat it in an entirely different manner.

One thing that has served to bring scientific testimony into deserved contempt, is the readiness with which experts are willing to testify upon the most slender evidence. We find men swearing positively as to what they regard as facts, when the evidence for these facts may be based upon some special and delicate method of manipulation, such as intricate and unusual illumination under the microscope. Hence, we find this astounding state of things, that when any scientific question comes up in court, it is easy to find a dozen men who will swear to one set of facts, and another dozen, of equal reputation, who are willing to swear to the opposite.

The causes which have led to this are not far to seek. Amongst others, we may note a desire for notoriety and popularity. The class of experts who deal in such testimony, know that nothing strikes the popular mind like stories which tell about difficult detective work. The tales of Cooper, in which his scouts and Indians determine obscure facts by very slight evidence excite the admiration of every boy, and there are no anecdotes more popular than those in which slender clews lead to important results. These professional experts wish, therefore, to become the heroes of similar anecdotes, and for this they are too often ready to sacrifice the life, liberty or property of innocent persons. We do not mean to say that they do not believe what they swear to; very far from it. But they work over a theory until facts and hypotheses become confounded in their minds, and the resulting testimony is far beyond their positive knowledge. Juries seem to feel this, and it was with pleasure that we observed that in the discussions in the jury-room, in the Hayden trial, the jury threw all the expert testimony aside as so much useless lumber in the case.

Microscpical Injection of Molluscs.

Dr. W. Flemming has originated* a method of killing molluscs for purposes of fine injection, which he has found very successful. He recommends freezing the animal by means of a mixture of ice and salt, and placing it, when frozen, in tepid water for a quarter of an hour; it is then found to be dead and stiff with the valves gaping, and the muscles no longer offer any opposition to the passage of the injection. Unlike many other methods of killing, this freezing process produces no injury to the tissues.

In injecting Lamellibranchs from the heart, there is great danger of extravasation. To obviate this difficulty, Flemming recommends wiping the surface carefully after insertion of the cannula, and then covering the animal with a soft paste of plaster of Paris. If this is done successfully, the cannula is firmly fixed in its place, and extravasation from the cut surfaces of the abductors and other dangerous places is effectually prevented.

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* "Archiv f. Mik. Anat.," vol. xv. p. 252.

TRANSACTIONS OF SOCIETIES.

NOTE.—It will afford us great pleasure to publish notes of the Transactions of any of our Microscopical Societies. The limited space at our command precludes the insertion of lengthened accounts of mere business details. We wish it also to be distinctly understood that these reports are published as received from the Secretaries of the different Societies, and the Journal is not to be held in any wise responsible for any statements contained therein.

San Francisco Microscopical Society.—The regular meeting of the San Francisco Microscopical Society was held Thursday evening, December 4th, 1879; an unusual number of members present. The business commenced early, with Vice-President Kinne in the chair. Professor Joseph Le Conte was elected corresponding member, and F. A. Holman, M. D., was proposed for a similar membership of the Society. Henry G. Hanks, the first President of the Society, was re-admitted a resident member, without the usual initiation fee required of new members.

After a brief discussion, it was voted to hold the annual reception of the Society on the 19th inst., at Mercantile Library Hall, and Messrs. Hyde, Hanks and Mouser appointed a committee to make the necessary arrangements.

A very interesting paper was sent in by Melville Atwood, Esq., and read by Vice-President Kinne. Specimens of rock sections accompanied the paper, which were shown and explained by the Secretary. Mr. Atwood's paper was on "The Importance of a Classification of Metalliferous Veins."

Of all the speculative employments, mining is, perhaps, the most uncertain. Miners of great experience and ingenuity are frequently at fault, and sometimes completely defeated in their search after paying ore-bodies and the mines abandoned, while men of less ability have afterward worked the same mines, from which they have derived large profits—so that any plan or method that tends to throw light on the subject, and assist the miner in his explorations, should be considered of value.

The proper classification of metalliferous veins or lodes (I prefer the Anglo-Saxon word lode) appears to me to be one of the first things required, and it seems surprising that, where such vast interests are at stake, it should have been so totally neglected.

As far as I am able to judge, the only way in which lodes can be correctly classified is by their enclosing rocks or the rock formation in which they occur, thus rendering an accurate determination of the enclosing rocks necessary. Some rocks are of a coarse and simple structure, and their mineral constituents may be resolved by the unaided eye, but by far the greater number are of so fine-grained texture as to defy ocular analysis, so that for their determination the use of the microscope is indispensable. For instance, totally different rocks sometimes have the same chemical composition, and are similar in external appearances, but a microscopic examination shows the internal structure to differ greatly. A classification of lodes would do much to stop the misuse and confusion of common mining terms, and many hackneyed phrases, such as "regular and well-defined walls," "clay walls, "true fissure veins," "perfect formation," etc., would be abandoned. Some of the most productive tin lodes in England have no walls, and the vein-stone appears to be an altered granite. (See Dr. Le Neve Foster's contribution to the Quarterly Journal of the Geological Society.) Again, the richest mine in Nevada—the Comstock lode—has only one, the foot-wall, the rock a dolerite. The principal gold lodes of California—the Eureka and Idaho, of Grass Valley, the Amador, of Sutter Creek, and others—can only be said to have a "hanging wall," the rock of which is generally a diorite or diabase, the latter being considered the ancient form of dolerite; so that "regular and well-defined" walls are not so good an indication of mineral wealth as is generally supposed.

Last year I had the pleasure of calling your attention to a simple mode of preparing rocks for examination of the *outer* surfaces with the assistance of a common pocket magnifier, and which I then thought would be of great assistance to the miner, in helping him to correctly determine the character of many of the enclosing rocks, and in many instances it was quite sufficient; but for a *correct* determination, after all, the microscope must be used, and at that time a cheap and easy way to cut the rock-sections was the difficulty I had to contend with. After many experiments, I found a simple plan by which it can be done at a little cost and labor, by the use of a few emery stones or blocks, of different degrees of fineness—say from one and a half to two inches square, and eight or nine inches long—the same as I have brought here for your inspection. The chips to be cut should be first made as thin as possible; the plan recommended by Mr. Rutley, to use a cold-chisel, the end let into a block of wood, and then by holding the specimen on the edge of the chisel and striking it a sharp blow with a light hammer, will generally give you a satisfactory chip. The chip must then be rubbed on the emery blocks, with water, till you get a good, even surface on one side of it, commencing with the coarse emery blocks first; then, with Canada balsam, fasten the smooth surface of the chip to a common glass slide, which is done by heating the slide over a spirit-lamp and then applying a small quantity of the balsam. As soon as the balsam liquifies, press the smooth surface of the chip into it, and then allow it to cool. The balsam is better to be dried, so that you can use it like a stick of sealing-wax. As soon as the slide and chip are cold, you can commence to rub the outer or rough surface of the chip attached to the slide, on the emery blocks, until you get it nearly thin enough for mounting. To finish, use the fine, smaller blocks, as you would a file. You can hold the section up to the light and examine it during the operation. Mount and cover the section with thin glass, in the usual way.

Amongst the specimens in the case which I have brought for your examination are two marked Nos. 1 and 2, which were cut in London, England, by a professional, with expensive apparatus. Those marked Nos. 3 and 4 are from the same rock, but cut by myself with the emery blocks, in the way I have endeavored to describe to you, and, if the mounting material was of as good quality, would be equal to the former in every respect.

In conclusion, it will give me great pleasure to show any of the members of this Society how to cut and mount the rock sections at any other time. At some future meeting I hope to be able to give the Society the result of my examination of the clays of the Comstock Lode, the most interesting and important work I have ever yet undertaken.

A vote of thanks was tendered to Mr. Atwood for his very interesting paper, and the Society adjourned.

New York Microscopical Society.—The Regular meeting was held Sept. 5, 1879, President Hyatt in the chair. The Librarian announced the following donations, for all of which votes of thanks of the Society were tendered, viz.: from Dr. Engels, Diatoms, sub-peat deposit from Carson, Nevada; Messrs. Hitchcock and Wall, about 50 copies of the "Transactions" of this Society, also a splendidly bound and lettered volume of their *American Quarterly Microscopical Journal.* From the Museum at Cambridge, Mass., a number of the "Bulletin of the Museum of Comparative Zoology."

Mr. Hitchcock read a short paper on the "Conjugation of the Zygnemaceæ," which was illustrated by blackboard drawings. Mr. Van Brunt then discussed some points which he had also observed in these plants, and both gentlemen afterwards showed some of the specimens as found in different stages of their existence. President Hyatt stated that he and the Recording Secretary, Mr. Shultz, attended the Buffalo meeting of the American Society of Microscopists, and enjoyed a very pleasant time, both in hearing the interesting papers and discussions, and witnessing a fine exhibition of instruments and objects, in which he and the Secretary participated, besides the excursion kindly given to the Society by the citizens of Buffalo, from that City to and from Niagara Falls, where a supper was given them; and in the evening a magnificent display of electric lights, over the Falls and surroundings, was witnessed by the assemblage to their delight. Among other objects exhibited were, by Mr. Hyatt, the living diatoms, Baccilaria paradoxa; and by Messrs. Hitchcock and Van Brunt, Zygnemaceæ, Spirogyra, etc. Mr. Hitchcock proposed a scheme which he thought would, if adopted by the Society, add greatly to the interest and value of the meetings. His remarks may be summed up as follows: In order to secure some interesting objects for exhibition at every meeting, he proposed that a number of the most active members should agree to collect specimens of living plants or animals for each meeting. These members should be divided into companies of two for each collection, and he had prepared a short list of members, arranged according to the plan proposed. During inclement weather it is expected that the gentlemen appointed will furnish mounted objects, or material, or apparatus of interest in place of living forms. In addition to this, it was proposed that there should be a popular address delivered every two months, upon the evenings of the regular conversational meetings. Invitations should be issued to ladies and gentlemen who are known to be interested in scientific studies. A scheme for table work was also brought forward, which was intended to afford practical instruction in methods of preparing, mounting, and studying specimens.

The Regular Conversazione Meeting was held Sept. 19, 1879. Mr. W. M. Aikman, of Brooklyn, was elected. Donations were received as follows: By Mr. Leaman, Spores of Equisetum; by Mr. Hitchcock, a photograph of Moller's slide of 100 diatoms; by the same, winter eggs of Pectinatella magnifica, mounted; by Mr. Hyatt, a slide of diatoms from Watkin's Glen, mounted by him; by Dr. Frank Deems, crystals of the Nitrate of Urea, mounted so as to exhibit crystalization each time the slide is moderately heated. There were also for exhibition by Mr. Hyatt, Copper Rain, Hair of Peruvian Mummy, Saws of the Elm Saw-fly, section of Blood Root (very fine ruby-like resinous spots included), Pollen of *Hibiscus trioneum* in situ, Deutzia crenata, showing stellate pubescence in situ, etc. By Mr. Hitchcock, male and female specimens of trichina spiralis, mounted by J. A. Close, M. D., Summerfield, Ill., Spirogyra Communis, with nuclei, stained with carmine.

The Regular Meeting was held Oct. 3, 1879, at which Mr. Hyatt exhibited a section of the silicious coat of *Equisetum hyemale* or common scouring rush, by polarized light—a gorgeous object. He announced that he prepared it by first scraping off the matter which adheres to the inner surface, then bleached it by steeping it in Labaraque solution, afterwards washing in alcohol, and mounting in balsam. Mr. Wall showed his method of mounting opaque objects in wax by cutting thin sheets of black wax into circles, placing a disk upon the slide, fixing a brass curtain ring in the wax by the application of heat, and covering the cell thus made by thin glass, after which it was finished in the usual manner. Mr. Hitchcock exhibited some algæ, etc., and Mr. Shultz, *Corethra plumicornis*, red Canthocamptus, and a variety of living objects.

A Public Conversazione was held Oct. 17, 1879. This was the first of the meetings provided for by a recent resolution. A popular address was delivered by Mr. J. D. Hyatt, the President. He was introduced by Mr. Braman, who made a few happy remarks upon the history and condition of this Society. The subject of Mr. Hyatt's address was "The Mechanism of Insect Stings," which he illustrated by blackboard sketches and greatly magnified colored drawings on paper. He fully explained to the audience the elaborate compound levers and muscles by which great rapidity and much power was displayed by the bee in thrusting its stings into the flesh, forcing its virus into the puncture it makes, thereby producing instant pain. He also stated that the easiest way to procure the honey bee's sting is to place a piece of soft leather so that the bee will attack it, by which means the sting will be found sticking in the leather, from which it may be removed, mounted, and examined. The address was attentively listened to by a very intelligent audience of about two hundred ladies and gentlemen, who, at the conclusion, were shown into the smaller meeting room, where were arranged twenty-nine microscopes with attractive objects. The exhibitors and their objects were as follows: Mr. W. L. Leaman, young oysters (by polarised light). Mr. A. J. Swan, mosquito's head, and Moller's 100 diatom platte. Mr. J. A. Hoyt, platino cyanide of magnesium (polarized). Mr. C. F. Park, Aulocodiscus formosus (diatom). Mr. J. D. Hyatt, barbs on sting of honey-bee, saws of Elm saw-fly, and living cheesemites. Mr. W. H. Mead, wing of butterfly, hairs of mouse, shaving of white pine (from a match), Daphnia pulex, and living entomostraca. Mr. A. A. Julien, crystals of gold, section of chalcedony (polarized light). Mr. B. Braman, Leaf of Eleagnus hortensis. Mr. J. L. Wall, multiple images of second hand of watch through eye of beetle. Mr. C. Van Brunt, lace-wing fly. Dr. F. M. Deems, circulation of blood in frog's foot. Mr. J. Warnock, quinate of quinine (polarized light), section of stem castor oil plant. Mr. C. S. Shultz, larva of corethra plumicornis (shadow gnat), and volvox globator (a plant in rotary motion). Mr. W. B. Mitchell, circulation in gold-fish tail. Mr. W. C. Hubbard, diamond beetle's elytra. Mr. W. M. Aikman, circulation in nitella (plant). Mr. C. F. Cox, circulation in anacharis (plant). Dr. L. Schöney, trichina spiralis (mounted). Mr. F. Collingwood, spicules of gorgonia (sea fan). Dr. D. Benson, Möller's platte of 80 diatoms, with names photographed.

The Regular Meeting was held November 7, 1879. President Hyatt in the chair. A letter from Dr. Chas. L. Swazey, New Bedford, Mass. (an associate member) was received, accompanied with substantial tokens of his interest in our Society, by 14 mounted slides of various interesting objects for the Cabinet; a vote of thanks was tendered him for his donation.

Mr. A. A. Julien then read a paper on "Preparation of Thin Rock Sections in the Field," which he practically illustrated by performing the work with such implements as he would use in the field. He stated that when a party who may be exploring in portions of country where the more refined apparatus for section grinding and preparing can not be procured, or where one is obliged to travel by mule train, where but little luggage can be transported, that the following will answer the purpose very well, viz.: A tin box about 2½x5 inches, containing a small box of flour emery (or, as a substitute, garnet may be picked up in many places and powdered right in the field), a small bottle of common balsam, made very hard, a few corks, some pieces of broken window glass, a few thin covers, or, if they are omitted, pick up mica from some of the rocks, and use the thin sheets of that instead (except in some cases where it would interfere with the use of polarized light upon some rocks); in addition to these a small piece of iron plate for grinding upon completes the outfit, all of which will fit into the tin box mentioned before. Now, as to the processes, which are simply as follows: Break off very thin flakes from the rock to be examined, a piece ¼ of an inch in diameter is large enough; take the small piece of smooth flat iron (a stove lid will do), place a little flour emery with water upon it, then, with the flake of rock upon the iron plate, press upon the section with a cork for a holder, and rub one side by grinding with the emery until that side has been made smooth and flat; take a small piece of the window glass, and by melting some of the balsam cement the smooth side of the section to the glass. Now take the glass in hand, and with the other side of the section, *down to the plate*, with emery, grind as before, until *newspaper print* can be clearly seen through it. This will answer well for ordinary examination (but with care many rocks may be polished finer and thinner than this). Now take one of the cover glasses or laminæ of mica, and with the melted balsam place it upon the uncovered side, and the section is ready for microscopic examination. All of which can be done in ten minutes anywhere in the field." After this very interesting and practical paper the meeting, upon motion, adjourned to witness the modus operandi of Mr. Julien's section preparing.

The Regular Conversazione Meeting was held November 21, 1879. Mr. Wm. Wales, of 361 West 34th Street, was elected as an active member. Objects brought for exhibition: By Mr. Wall, slide of pollen of Ipomæa purpurea. By Mr. Hyatt, prepared and mounted by himself, sections of California fossil wood (chalcedony); transverse and longitudinal sections of the shell of the oyster drill (Fusus cinerus); two palates of Tebemophorous Carolinensis (a common large land snail), one of them nicely stained and the other transparent; the latter he donated to the Society. After the meeting Mr. G. S. Woolman exhibited to the members some very fine stained sections prepared by Mr. Merriman, of Rochester. He also exhibited a complete medium-priced microscope, called the "Acme," and accessories, for sale by him and made by Sidle & Poalk, of Philadelphia—which stand was admired for its great utility and various improvements.

The Regular Meeting was held December 5, 1879. President Hyatt in the chair. Business of a routine character and of no interest to the public was transacted, after which were exhibited by Mr. Aikman, mounted lichens, also butterfly's wings; and Mr. Wales exhibited a new one-twelfth of his own make, just finished, which appeared to be a superior objective.

The Regular Conversazione meeting was held December 19, 1879. President Hyatt in the chair. Donations: By Mr. Hyatt of a lot of handled dissecting needles. By Capt. J. H. Mortimer, of the ship "Hamilton Fish," an associate member of this Society, 24 slides of coal tar derivatives for polariscope and paraboloid objects, prepared by Messrs. A. C. Cole & Son, the celebrated English mounters of microscopic objects; also a slide of the diatom Triceratium Joynsonii. A vote of thanks was tendered Capt. Mortimer for these beautiful and valuable presents, and the Corresponding Secretary requested to write him to that effect. From Mr. J. L. Wall, a bottle of shellac cement. Exhibited by both Messrs. Mead and Wales, each a Zentmayer's New Model Binocular, "Army Hospital" Microscope, which seemed to be one of the most efficient of working stands, and in some respects the best in the world. Mr. Hyatt, a number of slides of diatoms that he had taken from various localities, viz.: Port Morris, Morrisania, Bagnall, Watkins' Glen, Harlem Kills, etc., N. Y., all of which had been nicely cleaned by him and mounted, among them some rare specimens of circular and other diatoms. By Mr. Wall, pollen of Oenothera-biennis. These and the Mortimer slides, which were handed in by Mr. F. Habirshaw, made a very interesting exhibition of objects, after which, upon motion, the meeting adjourned.

CHAS. S. SHULTZ, Rec. Secretary.

EXCHANGES.

Subscribers who have a surplus of interesting microscopic material, or objects in any department of natural science, which they wish to exchange, may announce it, without charge, in this column. The following rules must be observed: 1. The privilege of announcing an exchange is confined to subscribers. 2. EXCHANGES only will be admitted. Sales and purchases for cash must be relegated to the advertising department. 3. Each exchange will be limited to three lines, and must be legibly written on a separate slip of paper (not embodied in a letter). Be careful about the address.

Nicely mounted slides, opaque, of the coal-tar products, chemically prepared, crystalline in form, showing their beautiful colors, in exchange for other well-mounted material; chemical name and formulæ attached; about a dozen varieties on hand. F. L. Bardeen, M. D., 80½ Meigs St., Rochester, N. Y.

Wanted, California or West Coast Algæ, for Atlantic or West Coast mounting. Rev. J. D. King, Edgartown, Mass.

Devonian, upper and lower silurian, carboniferous and cretaceous (Texas) fossils, given for others; lists exchanged; tertiary and cretaceous species especially desired. Also land and fresh-water shells, especially of the family *Unionidæ*, and minerals for fossils, other shells, or minerals. Berlin H. Wright, Penn Yan, N. Y. Reference, Ed. this journal.

Wanted, parts of brain or cord, man, supposed to be diseased; will give mounted slides of above, or choice of numerous histological preparations. Richard H. Lemmon, M. D., Castle Craig, Campbell Co., Virginia.

Slides mounted from injected sheep's kidney, human kidney with Bright's disease, rat's kidney, rat's liver and others, exchanged for any good and interesting slides. C. Blasdale, M. D., Jericho, Queens Co., New York.

Exquisite wild seeds, neatly mounted, in sets, by genera and species. Also pollens in balsam, arranged in same way. Rev. J. T. Brownell, Lyons, N. Y.

Wanted, a three-inch objective, first-class, in exchange for a Zentmayer Erector, unused and perfect, and cash. Rev. C. Van Norden, St. Albans, Vt.

To mounters: Large quantities of pure foraminifera, etc., for first class prepared American material; send samples to J. Green, The Cross, March, England.

Slides of pine pollen, so-called sulphur shower, which fell in eastern Pennsylvania, March 17. Diatoms, vegetable stainings, etc., in exchange. C. Henry Kain, 524 Cooper street, Camden, N. J.

Stained vegetable tissue, and polariscope objects, to exchange for any other mounted objects. A. P. Brown, P. O. Box 15, Camden, N. J.

Diatoms, Isthmia enervis, Campylodiscus clypeus, both pure; best Jutland cement-stein, etc. Wanted, good recent Pacific coast material. Correspondence invited. W. M. Paterson, Loftus, England.

Ferns, mounted or unmounted, for Northern species of same. Lists of those on hand and those wanted sent on application. Maj. R. H. Wildberger, Kentucky Military Institute, Farmdale, Ky.

Wanted, well mounted slides, in exchange for a German student lamp. Address H. Watson, 31 Aborn St., Providence, R. I.

A fine Liston's amputating knife, cutting blade 9½ inches, made by Hernstein, in perfect order, to exchange for a good Valentin knife. W. W. Munson, Otisco, N. Y.

Will exchange for well-mounted objects, human teeth sections from any part of tooth desired. H. A. Moyer, Kendallville, Ind.

THE AMERICAN
Journal of Microscopy,
AND
POPULAR SCIENCE.

Vol. III. NEW YORK, JANUARY, 1878. No. 1.

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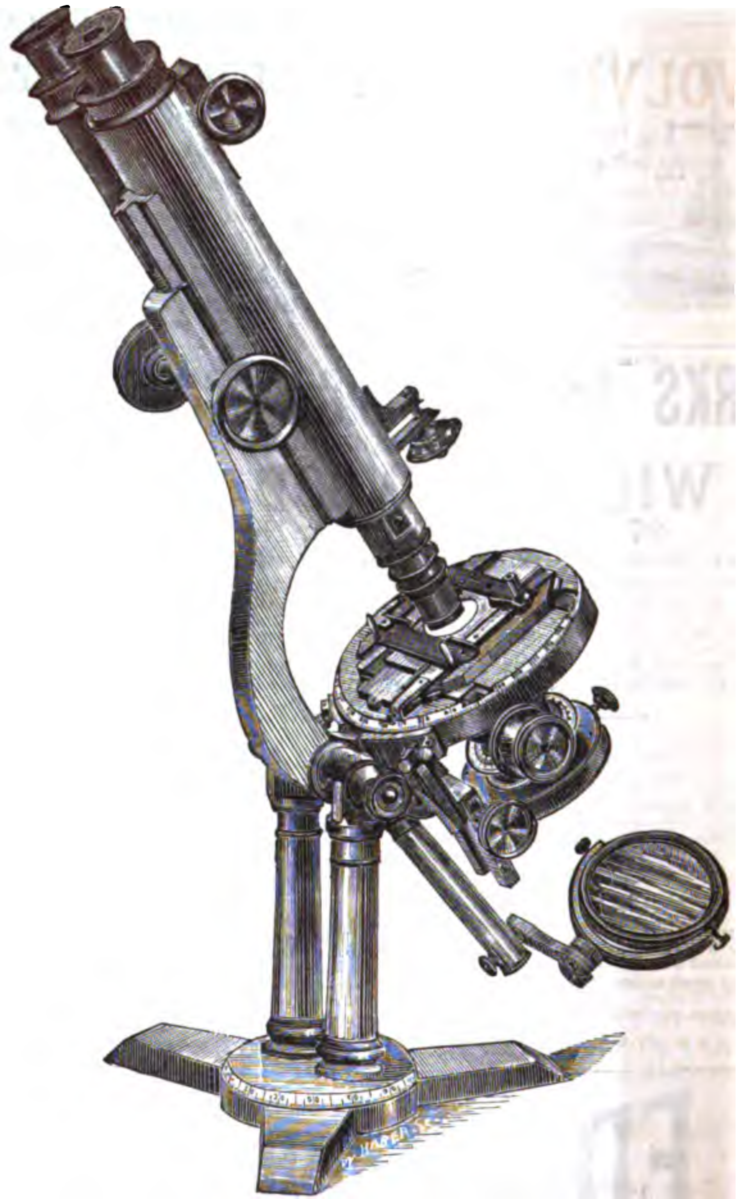

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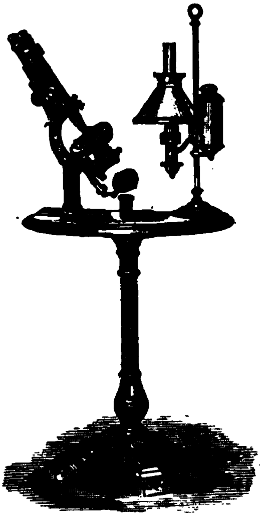

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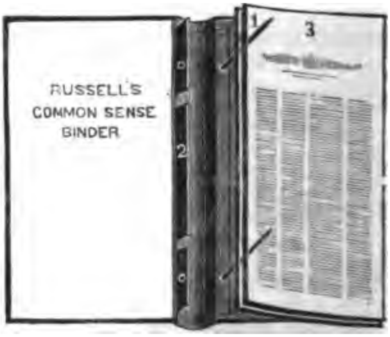

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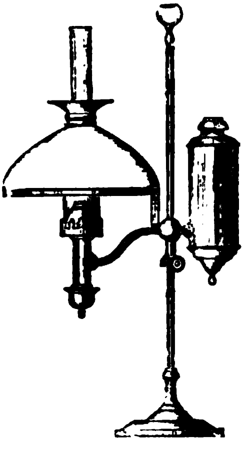

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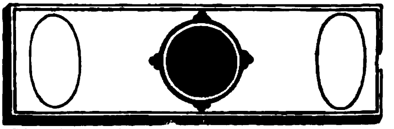

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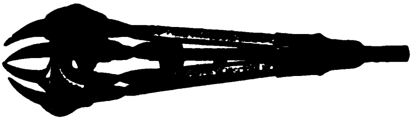

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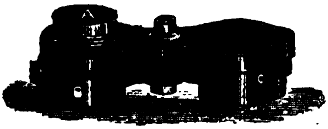

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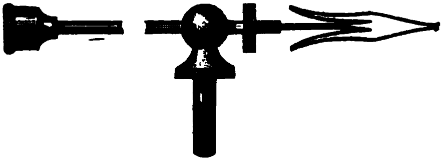

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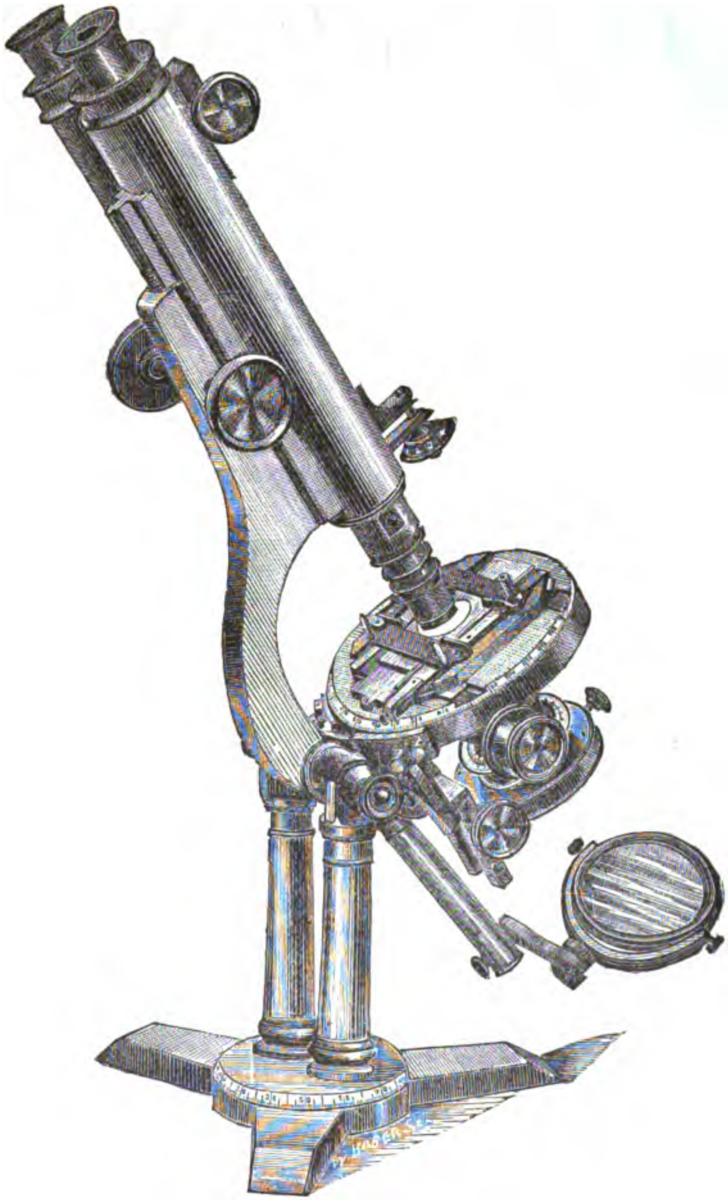

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English Brussels, Three-Ply and Ingrain. Elegant Stair Rods; also Stair Carpets, Carpet Lining, Velvet Rugs, Oil Cloths, Crumb Cloths, Mattings, &c., &c., very cheap, at the old place,

112 FULTON STREET, NEW YORK.

Carpets carefully packed and sent to any part of the United States, C. O. D., free of Express Charges. Call or send for Explanatory Circular and Price List.

J. A. BENDALL.

SOMETHING NEW.

I have completed arrangements whereby I am enabled to furnish MICROSCOPIST'S RULINGS on glass, absolutely accurate, and at very low prices.

PRICE LIST OF MICROMETRIC RULINGS.

100 to 1000	$1.25
100 to 2000	1.75
100 to 4000	2.50
Millimeters	2.75

RULINGS IN BANDS.

8 bands, 200 to 21000	$3.00
9 bands, 200 to 30000	4.00
6 bands, 1000 to 50000	5.00
11 bands, 200 to 60000	6.00
12 bands, 10000 to 120000	15.00

I would especially recommend the 12-band rulings. The bands vary in lines by 10000 to the inch, and are very similar to the noted Nobert's lines, while their low price puts them within the reach of all interested in the microscope.

G. S. WOOLMAN, Optician,
116 Fulton Street, New York.

MICROSCOPES AND ACCESSORIES OF ALL MAKERS.

THE
YOUNG SCIENTIST.

A Practical Journal for Amateurs.

PUBLISHED MONTHLY.

PROSPECTUS.

The subject matter with which we shall chiefly concern ourselves is very distinctly set forth in the title of the Journal. The following are the details of the several departments, and will serve to explain our aims and claims:

PRACTICAL SCIENCE.—Simple methods of performing experiments, and of constructing home-made apparatus, will occupy much of our attention. In this department directions for making collections, for preserving specimens of Natural History, and for forming and managing aquaria, etc., will find a place.

AMATEUR MECHANICS.—Directions for making designs and working drawings, and for working with lathes, carpenter's tools, scroll saws, etc.; and for soldering, cementing, varnishing, polishing, etc., special attention being given to new methods and processes, where these are found to be real improvements. The various operations mentioned will be applied to the production of special articles of practical utility.

NEW BOOKS.—New scientific and practical books will be duly noticed, so that those who desire complete and recent information on any subject may know where to get it.

CORRESPONDENCE.—In this department we intend to place our readers in communication with each other, and in this way we hope to secure for every one just such aid as may be required for any special work on hand.

EXCHANGES.—An exchange column, like that which has been such a marked success in the *Journal of Microscopy*, will be opened in the YOUNG SCIENTIST. Yearly subscribers who may wish to *exchange* tools, apparatus, books, or the products of their skill, can state what they have to offer and what they want, *without charge*. Buying and selling must, of course, be carried on in the advertising columns.

ILLUSTRATIONS.—The journal will make no claims to the character of a "picture book," but wherever engravings are needed to make the descriptions clear they will be furnished.

Terms—Fifty Cents per year.

Postage stamps of low denominations (1, 2, and 3 cents) received at their full value.

Trial Trip.

As our journal is too small and too low-priced to claim the attention of news dealers, we are compelled to rely almost wholly upon subscriptions sent direct to this office, and as the journal is new and untried, many persons would no doubt like to examine a few numbers before becoming regular subscribers. To those who wish to make a "trial trip" with us we will send the first four numbers for

FIFTEEN CENTS,

which is less than the regular rates, as we feel assured that those who make the trial trip will in most cases become regular subscribers.

CLUBS.

Where three or more subscribe together for the journal, we offer the following liberal terms:

3 copies for	$1.25
5 " "	2.00
7 " "	2.75
10 " "	3.50

Special Offer to Old Subscribers.

Not only for the purpose of increasing our subscription list, but as an acknowledgement of the good feeling which prompted so many to support a new and untried enterprise, we will send the YOUNG SCIENTIST *free* to any of our old subscribers who will send us two *new* names and *One Dollar*. That is to say, we will, to each of our subscribers for 1878, send three copies for $1.

Advertisements, 30 cents per line.

To avoid delay and mistakes address all communications to "THE YOUNG SCIENTIST, Box 4875, New York," and make all checks and orders payable to John Phin.

On the succeeding page we give a list of the prominent articles which have appeared in the first nine numbers of the YOUNG SCIENTIST.

☞ Among the articles which will appear at an early date are:

Complete Directions for Modeling in Clay and Plaster. These will be splendidly illustrated, and are so clear and simple that any intelligent boy or girl can follow them.

Engraving and Ornamenting Glass. How to cut monograms and ornaments on tumblers, wine glasses, and glass plates, by means of apparatus, which any boy or girl of a mechanical turn can make and use.

Simple Objects for the Microscope.

Monthly Guide to the most Interesting Objects in the Heavens, that can be seen with the naked eye or telescopes of low power.

How to Make a Balloon.

How to Study Botany.

How to Study Entomology.

The Turning Lathe; hints and instructions for amateurs.

Hints on Fret and Scroll Sawing.

How to Become a Good Mechanic; what Studies to Pursue and how to Study.

Finishing Wood-Work.

How to Make a Magnet out of a Poker without a Battery.

The Magic of Science. A series of the most recent and wonderful parlor experiments.

The Science of Magic. A series of articles explaining the tricks of magicians.

Home-Made Scientific Apparatus.

WHAT WE HAVE DONE.

The following is a list of the most important articles that have appeared in the Young Scientist during the past nine months:

Illustrated articles are marked *.

January.—Makeshift Apparatus—Its Successes and Failures; General Rules to be Observed in Using Cements; College Workshops; Our Aims; Aiding the Swindlers; Liquefaction of Oxygen; *The Art of Sharpening Edge Tools; *Penny Microscopes; *A New Slide for Microscopic Objects; Self-Lighting Lamps; Home-made Telephone; Lead in Paraffin Oil; Poisoned by Cheap Jewelry; Silk-Worms at Large; Literature vs. Gymnastics; Long-lived Errors; Iron Bird Shot; Non-Conductors for High Temperatures; the Paris Exhibitior; Plaster of Paris; Parasites on Canaries; A Good Mucilage; Brass Lacquering; Ink that will not Freeze; Magnifying Power.

February.—Beauty and Strength; *Crossing the Atlantic in a Twenty-foot Boat; *Simple Lessons in the Art of Photography; *Simple Legerdemain; The Toad and its Habits; Concerning Ourselves; A Good Watch for a Dollar; Will it Show the Animalcules in Water? The Art of Sharpening Edge Tools—Scissors; Mechanical Genius; *Cheap Stage Forceps for Microscopes; How to Measure the Magnifying Power of Microscopes and Telescopes; Characteristics of Various Woods.

March.—*How to Read a Drawing; A Good Education; *Wood Turning Tools; What is a Diatom? Our Journal and its Influence; A New Postal Law for the Discouragement of Science; What will the Weather be To-morrow? *Making Glass Apparatus; *A Ten-Cent Galvanic Battery; A Shower of Fire; What Power Shall we Use? Paste Eels; Plants Growing Under the Microscope; A Sanguinary Hoax; Finishing Microscopic Slides; Mechanical Work for Girls; Counterfeit Fossils.

April.—A Simple Musical Instrument; *How to Read a Drawing; *Simple Lessons in the Art of Photography; The Trial Trip; The Right to Make Patented Articles; Miss Heller's Second Sight; *The Development of Frog Spawn; Simple Hints for Beginners in Microscopy; Trichina; How to Solder; *Entomologist's Pliers; Tempering Small Steel Tools; Our Ten-Cent Battery; Iron Shot; Are Snakes Beneficial?

May.—*The Champion Kite, and How it was Made; *A Good Ten-Dollar Boat; Our Summer Numbers; Our Prizes; A Word to the Girls; *A Cheap Condensing Lens for Microscopes; A Fifteen-Cent Battery.

June —*How to Study Entomology; *The Champion Kite, and How it was Made; *A Good Ten-Dollar Boat; Our Trial Trip; The Study of Natural History; Something out of Nothing; *Mounting Board for Entomologists; Aquaria; A House Fired by a Milk Can; Lichen Ornaments; What Will the Weather Be?

July.—*How to Begin the Study of Botany; How to Study Entomology; Simple Lessons in the Art of Photography; How to Study Science; How to Make an Aquarium of Microscopic Objects; The Hydra; The Aquarium; Contributions for the Young Scientist; Fourth of July Pistols; New Photographic Process for Copying Drawings; *How to Make a Drawing Board that will not Warp; Veneering; Clothes-Moths, and How to Get Rid of Them; A Large Musical Box; Cementing Labels to Metal; Stand for Cut Flowers; Cure for Burns; Another House Fired by a Milk Can; Case Hardening; An Instructive Experiment.

August.—How to Make an Herbarium; How to Study Entomology; *An Interesting Experiment; *The Archer-Fish; To Prevent Day Dreaming; Canada Balsam Microscopes; Paste Eels; *A New Form of Stage Forceps; Articles in Preparation; Crystallization; How to Make an Æolian Harp; Hints on Filing; Iridescent Glass; Indelible Indian Ink; Hatching Alligator Eggs.

September.—*How to Make Indian Canoes; How to Make an Herbarium; Simple Lessons in the Art of Photography; *A New Form of Frog Plate; *A Collecting Microscope; Pond Hunting; Rules for Using Glue; A Story of Science; A Liberal Offer; Hints on Filing; Mucilage.

WHAT PEOPLE SAY OF US.

In a letter to the Editor, Oliver Wendel Holmes, the genial "Autocrat of the Breakfast Table," says: "I am much pleased with the Young Scientist. It makes me want to be a boy again."

"It is a little publication, calculated to call out and educate all the latent ingenuity and thirst for knowledge which the youthful mind possesses, and we hope it will win its way into every household in the land."—[Scientific Press.

"We have never seen a periodical, designed for youth, which came nearer to our ideal of what such a journal should be."—[Canadian Pharmaceutical Journal.

"The Young Scientist is one of the choicest publications for juvenile minds in this country. Every page treats on subjects of importance to young and old, portrayed in a clearly comprehensive manner, which at once interests the young idea in its careful perusal."—[Lapeer Clarion.

"The work is a copiously illustrated monthly, and is full of practical hints that will instruct and amuse the young folks."—[Industrial School Advocate.

"A small but elegant and very instructive monthly."—[Pittsburg Chronicle.

"Contains the best possible reading for the young of both sexes."—[Ottawa Journal.

"It is ably edited by John Phin, who will make a large place in the heart of the rising generation, if he persists in his venture. We hope his success in the field will be equal to the article furnished—first best."—[Sunset Chimes.

"The articles are written in a popular, readable style, and profusely illustrated."—Akron City Times.

"The Young Scientist is excellent in conception, and well designed to amuse and instruct young people."—[Chicago Evening Journal.

"The Young Scientist is a handsome monthly magazine, each number containing about 16 pages, handsomely illustrated. It will supply a place which has been heretofore unoccupied. The copy before us comes fully up to the promise of the prospectus."—[The Times, Iroquois, Mich.

"It is a journal which should be in the hands of both young and old, and is a great benefit to the young scientist as well as the advanced professor. It is a thousand times more valuable than the dime novel series, so much read by boys. Parents would do well to have it in their households.'—[The Iron Home.

A CHANCE FOR EVERY BOY AND GIRL.

However much may have been said against premiums, it is certain that the most successful journals have been those which have given special attention to this feature of their publishing department. Very few people like to work for nothing, but at the same time many a boy or girl will work for a nice watch, or a beautiful desk, that would not work for a mere cash commission. Attractive premiums therefore tend to increase the circulation of any journal, and thus they enable the publishers to improve the quality of the journal by distributing the expense of engravings, articles, clerk hire, typesetting, etc., over a great number instead of over a few. This increased circulation is also such an advantage to advertisers, as in some cases to more than counterbalance the cost of the premiums. And as the goods that are offered are always purchased in large quantities, they can be sold *with* the journal at prices considerably less than that for which they could be procured singly. The articles offered by us have been selected because they are supposed to be specially suited to our readers.

They are all the very best of their kind, by well known manufacturers, and warranted perfect in every respect. *The publishers of the* Young Scientist *guarantee that none of these premiums can be bought at retail for less than the prices given.*

RULES.

1. All lists on which a claim for a premium is made, must be so marked when sent in, but it is not necessary to state for what premium.

2. All subscriptions count, no matter from what post office or for what year they may be. We can supply all back numbers, and subscribers for 1878 or 1879 are equally acceptable.

3. Names should be sent in as fast as received. The subscribers will then receive their journals immediately, and others will be encouraged to subscribe. We will allow twelve months in which to get up the club.

4. The money must in all cases accompany the names.

5. Five specimen numbers will be furnished free to those who try to get up a club, and have sent one subscription. More may be had, by *canvassers only* at the rate of two cents each.

6. Many persons are deterred from getting up a club by the fear that if they do not get the entire number required, their labor will be wasted, or they will be compelled to take something they do not want. To avoid this difficulty, we have arranged so that those who do not succeed in getting the full number can pay the difference in cash. Suppose a subscriber wishes to obtain an "Family Microscope," price $15.00, and sets out to get subscribers, of which 40 are required. On trial he finds that he can get but 30, which is only three-fourths of the required number. By our rules he is entitled to three-fourths of the $15.00, and by paying the balance, $3.75, in cash, he can procure a microscope which at $15.00 is certainly as cheap as any in market.

7. Money should be sent only by P. O. order, bank draft, or in registered letters.

SPECIAL PREMIUMS.

With the manufacturers of the following Premiums we have made such special arrangements that we can give our young friends a great deal for very little work:

The Amateur's Microscope.

This Microscope has been manufactured expressly for this journal, and is equal to any $15.00 instrument in market. It has a substantial cast iron stand of new pattern; the stage is roomy, and the clips can be entirely removed so as to leave the stage free. It has draw-tube; fine Huyghenian eyepiece; concave mirror of pure silver, swinging for oblique light; glass slips and thin covers, and stage micrometer, all contained in handsome black walnut box. The objective is an achromatic French triplet and very good. Powers 40 to 250 diameters. Descriptive circular with engraving may be had on application. Will be given for 35 subscribers at 50 cents each, or will be sent by express for $13.00.

Family Microscope.

This is a French instrument, more finely finished than the above, and with a fine movement for adjusting the focus. It has the same objectives as the Amateur's microscope, but the eye-piece is not so strong. Sells usually for $17.50. Will be given for 40 subscribers, or sent by express for $15.00.

Printing Press.

By special arrangement with the manufacturers, we are enabled to offer the "Bonanza Printing Press" for seven subscribers at 50 cents. The Bonanza press is a complete outfit, type, roller, and everything necessary for printing cards. Send for full descriptive circular.

LIST OF PREMIUMS.

	Value.	No. of Subs. at 50 cts.
Microscopes:		
The new $20 Microscope. (See descriptive circular)	$20.00	110
The new Working Microscope, just brought out by Geo. Wale; has fine achromatic Objectives, rack and pinion for Coarse movement, and screw and lever for Fine motion; magnifying powers up to 500 diameters. (See descriptive circular)	35.00	140
The Household Microscope; a well known instrument. Power 100 diameters	5.00	20
The Excelsior Microscope. The best cheap microscope for dissecting, botanizing, etc	2.75	10
Wood's Botanical Microscope; has stage, clips, needles, glass slips, etc., in box	2.50	5
Pocket Magnifiers:		
3 lenses, mounted in rubber. Gives as high a power as can be conveniently used by hand	1.50	6
2 lenses, mounted in rubber	1.00	4
1 lens, " "	50	3
1 lens, " "	25	2
Opera-Glasses:		
No. 1. This is a neat instrument, having good lenses, and giving clear definition and a large field; it is black, finely finished, and has a black morocco case. It is not by any means a cheap-looking affair	5.00	16
No. 2. Similar to No. 1, but finer	8.00	30
No. 3. A handsome instrument of very superior quality	15.00	50
Drawing Instruments:		
No. 1. A handsome set of Swiss Instruments, contained in rosewood or mahogany box, with lock and key	15.00	50
No. 2. Swiss Instruments, in finely polished box	10.00	40
No. 3. German Silver Instruments. This set is quite sufficient for the requirements of those who desire to make mechanical or architectural drawings. There are no useless pieces, and all are of good quality; needle points, jointed pens, etc	7.00	30
No. 4. German Silver; a well finished, serviceable set	5.00	20
No. 5. Brass; an excellent set for beginners	3.00	10
No. 6. Brass; well made, in case	1.50	5
No. 7. Pencil Dividers	40	2

	Value.	No. of Subs. at 50 cts.
Scroll Saws:		
The Companion, complete, with turning lathe	5.00	20
The Companion Scroll Saw, alone	3.00	10
The Lester Saw	6.00	24
The Lester Saw, with lathe and circular saw	8.00	32
Tool Chests:		
No. 1	10.00	40
No. 2	5.00	20
No. 3	2.50	10
Pocket Tool Chest, good and strong, contains 20 different tools	1.00	3
Desks and Workboxes:		
No. 1. Finely finished Rosewood or Mahogany Desk	4.00	12
No. 2. Similar to No. 1	3.00	8
No. 3. Similar to No, 2	2.25	7
No. 4. Imitation Black Walnut, neat and good	1.25	4
Work-Box, imitation black walnut	1.25	4
Work-Basket, very neat fine wicker work lined with silk	2.50	8
Albums:		
Handsome morocco, gilt, with clasps; holds 50 pictures	2.00	6
Handsome morocco, gilt, with clasps; holds 50 pictures	1.50	5
Easel Album, single	1.00	3
" " double	1.25	4
" " cabinet size	1.25	4
Photographic Outfit	15.00	50
Watch, nickel plated, stem winder; an excellent timekeeper, as we know by experience	10.00	40
Books:		
Webster's Dictionary, latest edition, unabridged	12.00	40
Webster's Dictionary, pocket edit'n	1.00	4
Dick's Cyclopædia of Receipts; a large 8vo vol., containing instructions on almost every subject	5.00	20
Spon's Workshop Receipts	2.00	7
Frick's Physical Technics; an excellent manual of mechanical manipulation	2.50	10
Allen's Useful Companion and Artificer's Assistant; including nearly 6,000 valuable recipes	2.50	10
How to Use the Microscope—Phin.	75	3
Shooting on the Wing	75	3
Chemical History of the Six Days of Creation—Phin	75	3
Lightning Rods, and How to Construct Them	50	2
How to Use the Pistol	50	2
What to Do in Case of Accident	50	2

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131 Devonshire Street, Boston,

Receives and executes all orders for Microscopes, Objectives and Telescopes made by

ROBERT B. TOLLES.

SPECIMEN OF LETTERS.

London, 19th July, 1878.

Mr. Charles Stodder:

Dear Sir—The Tolles 1-4th and 1-8th Objectives that were tried by Mr. Dallinger (see American Journal of Microscopy, July, 1878) were purchased by me. Both these lenses are, in my judgment, superior to anything made this side of the Atlantic. Still I am wanting a fine higher power lens, and if there is anything better to be had in the world, I think Mr. Tolles is the man to do it.

J—— E——, M. D.

Jos. Gillott

STEEL PENS.

The well-known original and popular Numbers,

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JOSEPH GILLOTT & SONS, New York.

HENRY HOE, Sole Agent.

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OF THE FINEST QUALITY, AT

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3/23-7

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Manufacturer of

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329 East Twenty-third St., New York.

Would inform those who desire Optical Instruments, and parts of instruments (such as Eye-Pieces, Object-Glasses, Astronomical Instruments and Astronomical Eye-Pieces, Prisms of Crown and Flint Glass, Spectrum Apparatus, etc.) that he is prepared to furnish anything in this direction of the very best quality and at very moderate prices.

STUDENT'S SPECTROSCOPES for $60; and MICRO-SPECTROSCOPES and NICOL'S PRISMs, for Polarizing Apparatus. All kinds of auxiliary Optical Apparatus made to order. Send for Price Lists.

FOR SALE.

The Microscopical Outfit of a gentleman lately deceased. It includes

A Fine ROSS STAND.
A ZENTMAYER GRAND AMERICAN.
A Large CABINET OF OBJECTS.
Möller's TYPEN-PLATTE.
Nobert's RULED PLATE.
Browning's MICRO-SPECTROSCOPE.
A very complete Series of OBJECTIVES.
Etc., Etc., Etc.

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Assets, United States Branch.........	$3,959,901.00
Liabilities, " "	2,191,769.49
Surplus over all Liabilities............	1,768,131.51
Income " " 1877........	2,713,059.32
Expenditure " " 1877........	1,603,916.79
Surplus Income, 1877.................	1,109,142.53

J. E. PULSFORD, Resident Manager.

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